THE IMPACT OF LANGUAGE FRAMING ON CRITICAL ELABORATION IN SUSTAINABILITY EDUCATION

by

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ABSTRACT

Because what people do individually and collectively is not based solely on what they know, the way educators communicate concepts in sustainability education is of utmost importance. Framing may impact recognized antecedents of pro-environmental behavior (such as attitudes) as well as traditional educational outcomes (e.g., critical thinking). Because commonly used frames are based in metaphors that tend to portray nature as a resource and resist ecological realities (e.g., the finite nature of matter), sustainability education may actually undermine pro-environmental behavior. This study examines the impact of framing on critical elaboration in sustainability education.

Participants were college students in introductory ecology and recreation courses. Using a 2x2 fully factorial design, students read text that portrayed humans as either a part of nature (systems metaphor) or apart from nature (nonsystems metaphor) in either active or passive voice and responded using a thought-listing technique. Responses were then coded for critical elaboration. Data were analyzed using an analysis of variance, which revealed no interaction of voice and metaphor type effects. A comparison of main effects means revealed significant differences. Frames that used a systems metaphor rather than a nonsystems metaphor elicited higher critical elaboration scores. Frames that used active rather than passive voice elicited more critical elaboration. Implications for future research and for sustainability education are discussed.

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CHAPTER I

INTRODUCTION

Pro-environmental behavior, defined as "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002, p. 240), is a fundamental goal of environmental education. According to Worldwatch Institute (2004), "the single-minded pursuit of consumption not only will undermine the quality of life of those in the consumer society, it will diminish the ability of those outside the consumption class to meet their basic needs" (p. xviii – xix), and the major ecological issues facing this generation, from global warming to the loss of biodiversity, are the result of this unchecked consumption. The 12% of the world's people living in North America and Western Europe account for 60% of resource consumption (Assadourian et al., 2004). In addition, the United States, with just 4.5% of the world's population, releases 38% of global carbon dioxide emissions (Energy Information Administration, 2005). These figures illustrate why educators must find a way for students, and the population as a whole, to embrace pro-environmental behavior.

Environmental education, recognized as the origin of sustainability education, has been called on to create an ecologically literate population who will actively participate in pro-environmental behavior, but success has been mixed (Zelezny, 1999). One important reason for this is the common assumption that knowledge leads directly to

behavior, but foundational studies exploring the relation between knowledge and behavior have shown that the path is not direct. It is affected by other variables such as attitude and awareness (Borden & Schettino, 1979; Pooley & O'Connor, 2000), citizenship and problem-solving skills (Sia, Hungerford, & Tomera, 1986), locus of control, action skills, personality, knowledge of issues (Hines, Hungerford, & Tomera, 1986; Hungerford & Volk, 1990), and social feedback and social norms (Schultz, 2000). Indeed, in all of the models that have been developed to explain how environmental education can lead to pro-environmental behavior, both knowledge and attitude are crucial. Yet sustainability educators often overlook attitudinal change as part of their educational mandate, focusing instead on knowledge alone. This study addresses that shortcoming by considering the attitudinal variable as well.

Because sustainability education is called upon to foster pro-environmental behavior, but often neglects important antecedents, this study drew on both the education and persuasion literature in using critical elaboration as an outcome of educational interventions. Research in psychology suggests that elaboration, meaning careful consideration of an issue, is essential for lasting attitude change (Petty & Cacioppi, 1986; Petty & Cacioppi, 1996). Because attitudes "arise spontaneously and inevitably as we form beliefs" (Ajzen, 2001, p. 30), education that activates a more careful consideration of underlying beliefs is critical. Further, the result of elaboration is that attitudes will be resistant to counter-pressure, and will be more accessible, stable, and likely to impel behavior (Petty & Cacioppi, 1996). Because both knowledge and attitude are important factors in attaining the goals of sustainability education, this study focused on a construct

synthesized from the education and attitude literatures. Specifically, it involved the merging of critical thinking and elaboration into what is called critical elaboration.

Perhaps the best way to activate critical elaboration is framing, the intentional use of words to facilitate and shape understanding (Lakoff, 2004). Framing can influence understanding and attitudes (Petty & Cacioppi, 1996). It is widely agreed that facts and ideas do not exist in isolation in our minds. Schema theory suggests that one word or fact activates a larger mental picture, or schema (Anderson, Reynolds, Schallert, & Goetz, 1977; Brewer & Nakamura, 1984). Humans think using an "extensive, but unconscious, system of metaphorical concepts" (Lakoff, 1995, p. 177) and language activates these metaphors. This is especially important in teaching ecology because framing, by activating critical elaboration, can challenge common misconceptions resulting from cultural metaphors that undermine understanding ecology and the role of humans in ecosystems.

A look at research on ecological misconceptions is illustrative in terms of framing and critical elaboration. Misconceptions about ecology and ecosystem processes, including matter cycling, energy flow, and natural selection have been widely studied (Armstrong, 1997; Griffiths & Grant, 1985; Hellden, 1995; Munson, 1994; Smith & Anderson, 1986). For example, matter cycling is narrowly understood among students who commonly believe that matter is created and destroyed in biological processes (Smith & Anderson). If humans were able to create matter, we would live in a world without limits; if humans were able to destroy matter, producing "disposable" items would not be an ecological liability. That matter is limited is rebuffed by consumer culture, and misconceptions about the limited nature of matter are at least reinforced, if

not created, in how culture talks about, or frames, these concepts in everyday conversation. From advertising slogans like "Crunch all you want, we'll make more" (Doritos campaign) to ecological textbooks that emphasize the cycling process rather than the limited nature of matter (Cachelin, Norvell, & Darling, 2010) to the Guidelines for the Initial Preparation For Environmental Educators (Simmons et al., 2004) which suggest only that educators should be able to "describe biological, geological, and chemical cycles and/or processes that played a prominent role in shaping an ecosystem," (p. xx), a conceptual understanding of matter as finite is not emphasized. Prevalent frames do not challenge students to critically elaborate on the ecological realities of matter cycling. Instead, they conform to culturally-shaped schema in which resources are conceived of and experienced as unlimited.

Syntax is an element of framing that plays an important role in students' ability to evaluate and respond to complex ecological topics and issues (Chenhansa & Schleppegrell, 1998). In science texts, as in science writing, abstract concepts are explored using the passive voice as opposed to a more empowering approach. Concepts like habitat loss, biodiversity, population growth, over consumption, and introduced species, central to the current study of ecology, are frequently presented as either the passive subject or the object of the sentence, meaning that there is no concrete actor. Consider, for example, "Bengal tigers once roamed widely across India and Southeast Asia. Now they're in trouble because of habitat loss and people killing them illegally for their bones, which are used to make traditional Asian medicines" (Braus, 1994, p. 7, as cited in Chenhansa & Schleppegrell). When asked the cause of the tigers' trouble, students overwhelmingly responded that people were killing them, as opposed to

mentioning habitat loss, demonstrating, perhaps, the relative strength of active versus passive voice (Chenhansa & Schleppegrell). Syntax can either dissuade or encourage involvement and as such it has an important role to play in framing messages to activate critical elaboration.

Additionally, language frames that relegate issues to the category "environmental" separate humans from the environment and implicitly make the environment less relevant, while consideration of these issues from a social perspective involves humans more. Shellenberger and Nordhaus (2005) provide a powerful example:

> Why, for instance, is a *human*-made phenomenon like global warming — which may kill hundreds of millions of *human beings* over the next century — considered "environmental"? Why are poverty and war not considered environmental problems while global warming is? What are the implications of framing global warming as an *environmental* problem – and handing off the responsibility for dealing with it to "environmentalists"? (p. 12)

This example makes obvious not only the role that framing can play, but also hints at the results of such separation. Perhaps more importantly, Shellenberger and Nordhaus suggest that:

> The concepts of "nature" and "environment" have been thoroughly deconstructed. Yet they retain their mythic and debilitating power within the environmental movement and the public at large. If one understands the notion of the "environment" to include humans, then the way the environmental community designates certain problems as environmental and others as not is completely arbitrary. (p. 12)

The consistently expressed divide between humans and nature is indicative of the fundamental problem in the metaphors people live by. Traditional framing activates the metaphorical concept "humans = non-nature" and this conception plays a powerful role in shaping the synthesis and interpretation of ecological information. While students can attain an academic understanding that humans are included in natural systems, language,

and the metaphors upon which they are based, inhibits students from consistently internalizing this knowledge and seeing themselves and their actions as ecologically relevant. This is significant because involvement and relevance have consistently been shown to be critical in fostering elaboration (Johnson & Eagly, 1989). It is also promising because dissonance may foster elaboration. As such, a dissonance-inducing frame that intentionally involves humans as a part of the system may provide a powerful tool in eliciting critical elaboration.

Frames may be intentionally manipulated to clarify ecological realities that are obscured by language use, and counter the variety of cultural messages that undermine critical elaboration and consequently pro-environmental behavior. For the purposes of this research, an active system frame (ASF) was defined as one that takes a systems-approach to the environment —including humans as *a part of* rather than *apart from* ecosystems, and uses active rather than passive voice. For example, teaching students that "we are all solar-powered," a notion which encompasses these criteria, may be more meaningful and drive home a more personally relevant conceptualization of the realities of energy flow than discussing the laws of thermodynamics. Similarly, teaching students that there is no "away" to which to throw things may provide the much needed impetus for critical elaboration that might ultimately result in conservation. With language being constitutive of reality, as much as reflective of it, intentional frames may provide a deeper and more lasting understanding of ecology by activating critical elaboration.

Yet frames that are out of step with common cultural metaphors may elicit cognitive dissonance (Festinger, 1957), a motivational state that can either undermine or support critical elaboration. Cognitive dissonance theory suggests that people seek

consistency in their underlying beliefs and thoughts. As a result, presented with dissonant information, people will find a way to make it consistent with their beliefs in one of three ways: they will either 1) reject new information and strengthen their own ideas rather than challenging existing beliefs, 2) minimize the importance of the information such that the inconsistencies become less important, or 3) change their attitudes and underlying beliefs (Petty & Cacioppi, 1996). Text that implements language frames designed to disrupt the common metaphors society lives by, decentering culturally normative messages that displace critical understanding of ecology as a driver of behavior, will likely induce cognitive dissonance. Thus, active systems frames may or may not be successful in activating critical elaboration and consequently reaching the goals of environmental education. Therefore, the purpose of this study was to determine the impact of frames on critical elaboration.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this study was to examine the effects of framing on critical elaboration as a proximal goal of environmental education. To lay the groundwork for the study, this chapter reviews four bodies of literature: 1) environmental education as a precursor to sustainability education; 2) critical thinking; 3) persuasion/elaboration literatures; and 4) framing, before concluding with theoretical linkages and hypotheses.

Environmental Education

Because the goals of environmental education (EE) are complex, including changing knowledge, attitudes, skills, and behavior, EE has met with mixed success. Since its inception in the early 1970s, educators have not seen large-scale popular engagement in pro-environmental behavior. To more fully understand this issue, a brief consideration of EE's definition and known impacts along with the different models that have been proposed to achieve pro-environmental behavior (PEB) are reviewed. These models provide important information about variables that warrant attention in setting up educational interventions to be successful in this context. Guided by this information as well as obstacles to past EE success and measurement, a new model, dependent on more commonly researched social science theory, is described. This model provides the

structure for exploration into a newly developed dependant variable that works toward bridging EE and PEB.

Definition

The definition of environmental education (EE), described in The Tbilisi Declaration (1977), sheds light on the assumptions that have shaped both practice and research in the field for many years. The goals of EE are:

1. To foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas;
2. To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
3. To create new patterns of behavior of individuals, groups, and society as a whole towards the environment. (as cited in Simmons et al., 2004, p. 2)

These goals are extraordinarily diverse, targeting awareness, concern, knowledge, values, attitudes, commitment, skills, and behavior. Drawing on early research efforts, the sequencing of these goals implies that PEB will result from the synergy between awareness, concern, knowledge, values, attitudes, commitment, and skills. The extent to which it actually does result from these and other variables is debatable. Moreover, measures of success or failure become difficult as this definition encompasses both proximal goals (awareness, concern, knowledge, values, attitudes, commitment, and skills) and distal goals (pro-environmental behavior in all its forms). Most environmental psychologists and educators believe that environmental education can result in PEB (Bamberg & Moser, 2007; Borden & Schettino, 1979; Hammit, Freimund, Watson, Brod, & Monz, 1996; Hines et al., 1986; Iozzi, 1989a; Kollmuss & Agyeman, 2002; Sia et al., 1986; Volk & McBeth, 1998; Zelezny, 1999) and the models that are specifically based on this assumption are discussed in the pages that follow.

Successes and Failures

According to the environmental education literature, analyses of environmental education programs have demonstrated more success than failure, though significant problems have been reported in meta-analyses of EE outcomes. These problems suggest caution in celebrating success (Bamberg & Moser, 2007; Coyle, 2005; Hines et al., 1986; Iozzi, 1989b; Leeming, Dwyer, Porter, & Coburn, 1993; Volk & McBeth, 1998; Zelezny, 1999). Leeming et al., in their comprehensive outcome research, found that 41% of EE interventions resulted in positive effects and another 17% reported mixed effects. Zelezny analyzed EE interventions from 1971-1996 and looked at her data in two categories: classroom and nontraditional settings. She found that all classroom interventions resulted in improved environmental behavior, and 44% of interventions in nontraditional settings reported improved environmental behavior. Treatment effects (r^2) for educational interventions in the classroom were 0.65, compared to 0.27 in nontraditional setting interventions (Zelezny). She also found that interventions that actively involved participants, interventions with participants younger than 18, and interventions with longer dosages were more effective in increasing pro-environmental behavior. Volk and McBeth divided effects into specific outcome categories and found that attitude changes occurred 48% of the time that they were targeted; sociopolitical knowledge and cognitive skills increased 100% of the time that they were targeted; increased ecological knowledge occurred 87.5% of the time that it was targeted; knowledge of a specific environmental issue occurred 85% of that time it was targeted; and 71% of the programs that targeted responsive environmental behavior were successful at some level. These data appear promising, yet it is worth considering

obstacles to synthesizing these data, particularly in light of the chronic disconnect between practitioners and researchers.

Researchers who conducted these meta analyses universally described obstacles (Bamberg & Moser, 2007; Coyle, 2005; Hines et al., 1986; Iozzi, 1989b; Leeming et al., 1993; Volk & McBeth, 1998; Zelezny, 1999). The most cited difficulty in accepting published successes is the frequent use of self-report data when considering results about behavior (Leeming et al.; Zelezny). Also cited as issues were faulty measurement instruments, confusion regarding the unit of analysis as a classroom rather than the individual, and the durability of these changes given that follow-up data were infrequently collected. According to Zelezny, of the studies that did in fact measure behavior, 89% used self-reported or inferred data rather than observation-based data. Self-report issues aside, the lack of a universal measurement instrument for proximal goals of EE also presented problems. Volk and McBeth note that 55% of the studies did not include a measure of instrument validity and frequently, measurement tools were created for the purpose of individual studies. Further, all of the outcome research and meta analyses cited expressed concern about the lack of follow-up to determine the durability of interventions. Many researchers have investigated the immediate effect of short-duration field experiences (Knapp & Barrie, 2001; Knapp & Poff, 2001; Palmberg & Kuru, 2000 as cited in Farmer, Knapp, & Benton, 2007), but few have studied the long-term effect of such programs. This is significant in light of the fact that more than 20 million students visit informal science and environmental field centers each year (Ramey, Walberg, & Walberg, 1994 as cited in Farmer et al.). The National Environmental Education Foundation echoes these concerns saying: “many ‘educational’

efforts were really little more than informational excursions and were not having much effect at all on creating deep environmental literacy, application skills, or a sense of stewardship in young people" (Coyle, 2005). Further, my experience as a practitioner of EE and interim director and board member of the state EE affiliate organization gives me the confidence to suggest that most EE programs are conducted by people with little training in education or social science, and that program evaluation remains largely outside of the expertise of most practitioners. It is only through national guidelines, inconsistently received and understood by practitioners and administrators, that research filters down to practice. Thus, most EE practice goes critically unexamined and as such cannot be qualified as a success or failure. Finally, publication bias is a concern; it is likely that only research that shows significant success would be published. This may be especially problematic for summarized research. Zelezny reported on this issue stating:

> It is possible that the studies that have been published may be biased if they include many studies with Type I errors. To rule out this bias, Rosenthal (1979) developed a way to quantify the tolerance for null results. Using his method, I recorded the exact p values for each study in this review. Using the normal distribution table, I converted each p value to a z score. I then summed standard normal deviates (zs; $z_{total} = 28.575$) and used them to calculate Rosenthal's equation to find the tolerance for null results. According to Rosenthal's recommendations, these estimates indicated that the file drawer problem was not likely and that the sample for this review was not seriously biased. (¶ 16)

Yet, Zelezny was only one of seven summary documents cited in this section.

It is not only the tenuous nature of the published data that undermines confidence in the impact of EE, but also its implementation, and its diversion from PEB as a goal that pose significant problems. Environmental education is often implemented as an after-thought or a supplement to more established curricula, employing a shotgun approach without proper scope, sequence, coherence, and continuity necessary to affect

behavioral change. Further, much current EE practice fails to get to the heart of what EE should be –an experience that enhances critical thinking and thus affects PEB. Environmental education as it is practiced rarely calls for an examination of underlying beliefs and understandings. It has drifted from its initial intent, in part, due to the current emphasis on standardization in the quest for wider acceptance. It is often celebrated as a triumph of science learning, and is cited as aiding peripheral goals such as better performance on academic achievement tests, reduced discipline and management issues, increased enthusiasm, pride, and ownership in accomplishments (Lieberman & Hoody, 1998). Yet an exclusive focus on these elements may be undercutting a more goal-oriented approach to sustainability education. A return to PEB as a goal, and an intentional sequence of educational programming, is essential if EE is to be effective.

Environmental Education Models

Foundational studies in the EE literature that explore the relationship between education and behavior have shown that the path is not a direct one; rather, it is affected by many variables such as attitude and awareness (Borden & Schettino, 1979; Pooley & O'Connor, 2000); citizenship and problem-solving skills (Sia et al., 1986); locus of control, action skills, personality and knowledge of issues (Hines et al., 1986; Hungerford & Volk, 1990); personal and collective competence (Chawla, 2007) and both social feedback and social norms (Schultz, 2000). In fact, the contemporary EE literature shows increasingly complex models of PEB, illustrating a growing awareness of both the indirect relationship between EE and PEB, and the effects of context. Social science theories assert an equally long road between knowledge and behavior, citing similar and overlapping issues. These include motivation and ability to elaborate on messages (Petty

& Cacioppi, 1996), norms, control beliefs, and beliefs about particular behaviors (Ajzen, 1992), and personal norms relating to responsibility and awareness of consequences of actions (Schwartz, 1977). Yet, understanding the relation between the proximal goals of EE and their connection to PEB is critical.

Borden and Schettino first studied the concept of environmental behavior change as a result of EE in 1979. Their work was based on an attitude construct from psychology in which attitude has cognitive, affective, and conative (behavioral) components, such that knowledge led to awareness, which led to action. Their work showed that EE aimed at behavioral change should include both affective and cognitive elements, as both were related to verbal and actual commitment to change. By virtue of this work, and the more formalized goals of EE, a linear model for behavioral change evolved (Hungerford & Volk, 1990).

Results of research on this model were mixed. It became clear that behavior change was a more complex concept than was initially understood. For example, Sia et al. (1986) suggested that citizenship and problem-solving skills were being largely ignored by environmental educators and began exploring predictive variables including environmental sensitivity, environmental action/knowledge skills, locus of control, personal attributes, and attitudes about pollution/technology. They found that environmental problem-solving skills and citizenship participation were strong predictors of behavior change.

Hines et al. (1986), Figure 1, proposed a new and more realistic model of PEB. This model represents a logical progression from the research that had been done. In this model, the intention to act and situational factors are the final stage before action occurs.

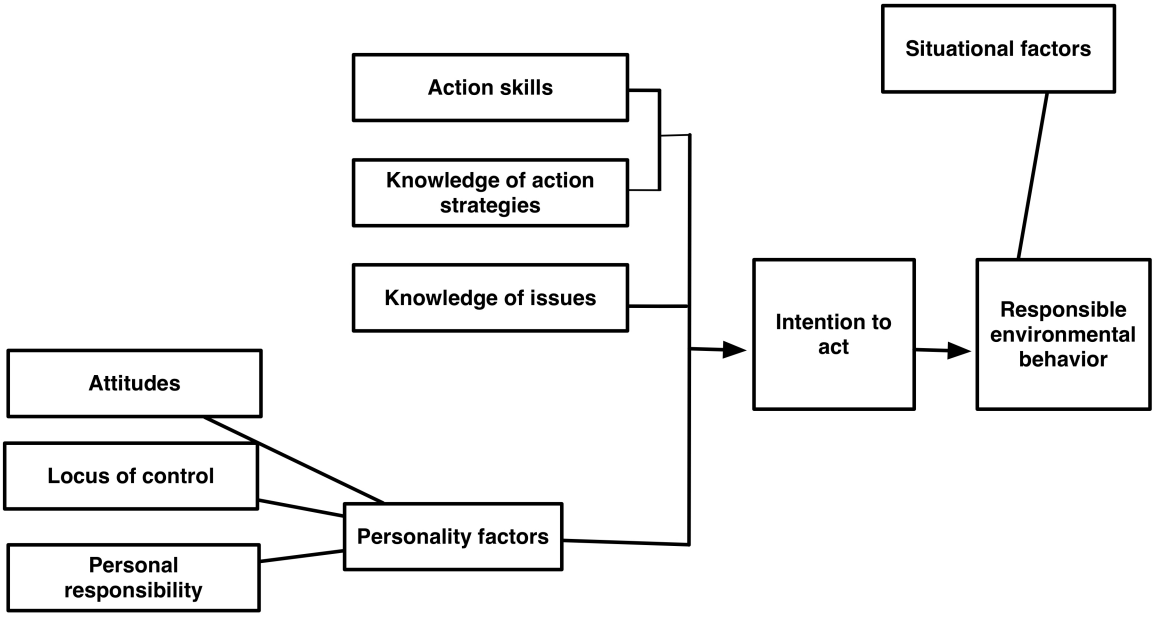

Figure 1: Hines: EE Model, 1986, p. 7

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This is because an individual who intends to act will more likely do so and "it appears that the intention to act is merely an artifact of a number of other variables acting in combination" (Hines et al., 1986, p.6). The addition of situational factors is important because such factors often undermine the intention – behavior relation. Examples of such situational variables are economic and social pressures. Additionally, research supporting this model calls for an emergence of greater specificity about attitude and knowledge constructs needed for change to occur (Hines et al., 1986). This model shares much with the more commonly accepted theory of reasoned action (Ajzen & Fishbein, 1980), later modified to be the theory of planned behavior (Ajzen, 1992).

Research on the Hines model suggested to Hungerford and Volk (1990) that the relationship was yet more complex. They proposed *entry-level* or prerequisite variables, including environmental sensitivity, knowledge of ecology, and attitudes toward

pollution and technology (see Table 1). These things in combination with ownership variables and empowerment variables would lead to "citizenship behavior." While o*wnership* variables were present in prior models under the name of knowledge, they differ a bit here in that this ownership knowledge is issue-based and accompanied by a personal investment. The final steps, *empowerment variables*, include knowledge and skill in using environmental action strategies, locus of control, and intention to act. Interestingly, this model is the first to consider citizenship behavior the equivalent of PEB, yet this nuance remains unexplored. Curricula were designed that incorporated many of these variables in a model known as issue investigation and action training. This model has proven successful in achieving PEB in many studies (Culen, 1994; Ramsey, 1993; Sobel, 2004; Wals, 1990). The incorporation of issue investigation combined with community participation underlies place-based education as well (Sobel, 2004). In fact, these approaches have been so successful that they are being advocated today by the

Table 1: Hungerford and Volk: EE Model, 1990, p. 10

Entry level	**Ownership**	**Empowerment**	**Citizenship behavior**
Environmental "sensitivity" Knowledge of ecology Attitudes toward pollution and technology	In-depth knowledge of issues Personal investment in issues and the environment Knowledge of the consequences of behavior (+ and -) Personal commitment to issues resolution	Knowledge of and skill in using action strategies In-depth knowledge of issues Locus of control Intention to act	

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National Environmental Education Foundation (Coyle, 2005).

More recently, Kollmus and Agyeman (2002) proposed the following model (see Figure 2). The theory of reasoned action (Ajzen & Fishbein, 1980), which suggests beliefs and attitudes will result in rational behavior, and social learning theory, which emphasizes social factors of learning, support the notion that both sociological and individual factors are important influences on behavior. Also of note is that the literature examined thus far fails to give external cultural variables such as social marketing their due (Coyle, 2005; Kollmuss & Agyeman, 2002). Yet, in the EE model (Figure 2), these variables are included. In addition, the underpinnings of constructivist learning theory (Ausubel, 1968, p. 140) are now explicit in the attention paid to misconceptions and blockages to learning and to enacting PEB.

Recent Trends

While there are elements of respected social science theories in all of these models, researchers (Bamberg & Moser, 2007; Hansla, Gamble, Juliusson, & Garling, 2008; Wall, Devine-Wright, & Mill, 2007) are beginning to suggest that the key theoretical underpinnings for PEB should include an integration of the theory of planned behavior (Azjen, 1991) and norm activation theory (Schwartz, 1977). These theories are well combined because the first was a hedonistic model, while the second was based on prosocial motives, and PEB is described as a mixture of both (Bamberg & Moser, 2007). Norm activation theory explained pro-environmental behaviors "like energy conservation (Black, Stern, & Elworth, 1985), recycling (Guagnano, Stern, & Dietz, 1995), travel mode choice (Hunecke, Blöhbaum, Matthies, & Höger, 2001), and pro-environmental

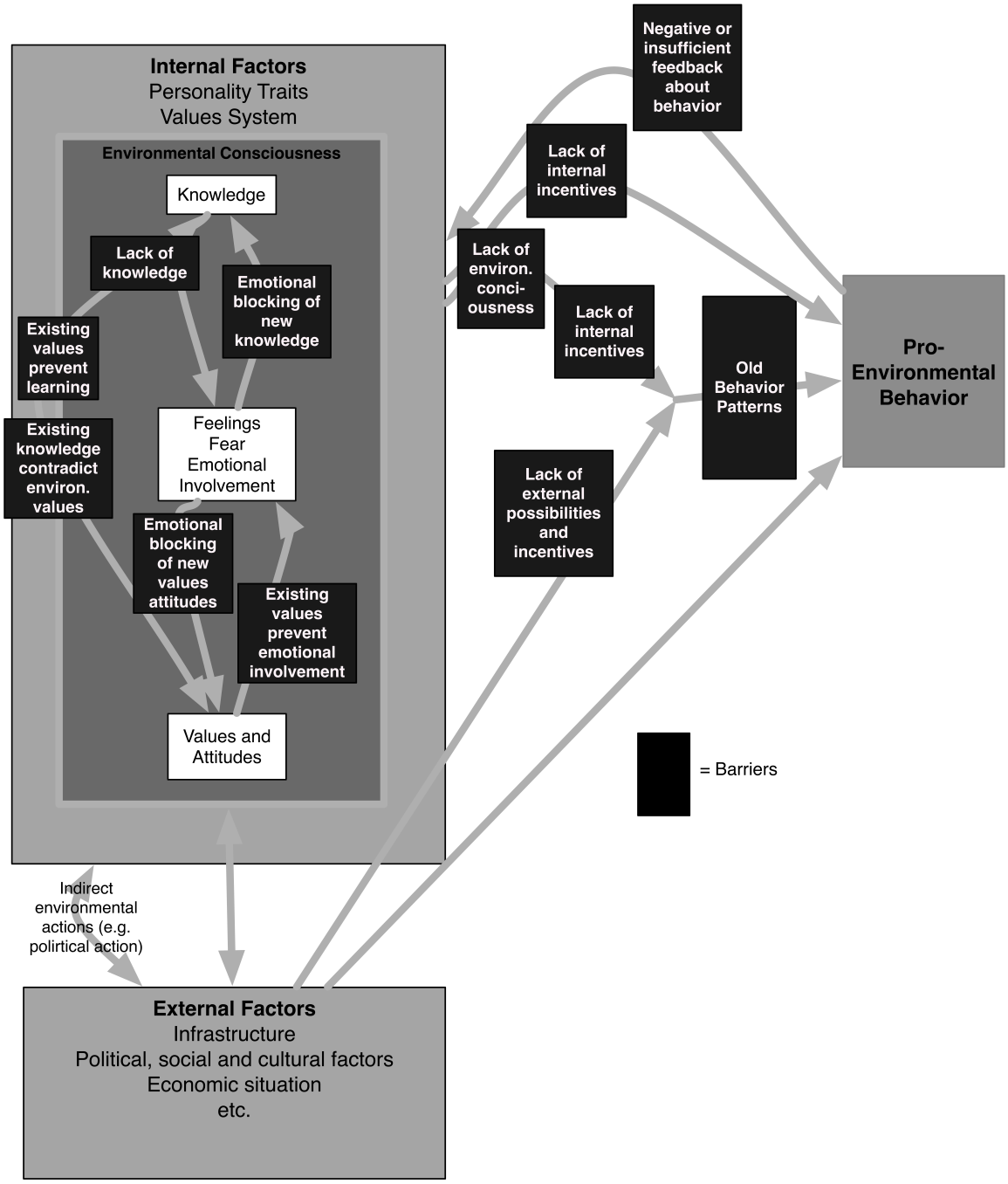

Figure 2: Kollmuss & Agyeman: EE Model, 2002, p. 257

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buying (Thorgersen, 1999). Further, they noted that Hines et al. (1986) found a mean correlation of $r = 0.33$ between a feeling of moral obligation to preserve the environment and pro-environmental behavior. Figure 3, a model from Bamberg and Moser (2007) merges the theory of planned behavior and norm activation theory in the path to PEB using hierarchical linear modeling to do an analysis. While this model does a good job of synthesizing important theories, and utilizes measurement tools that are more widely accepted, its focus is almost exclusively on attitude-behavior consistency rather than the generation of attitudes and knowledge.

A more complete model would include knowledge construction and attitude change as well as elements from norm activation theory and the theory of planned behavior. The ideal study would measure impact at many different junctures in a larger model, much like what is attempted below, and would need to include an educational

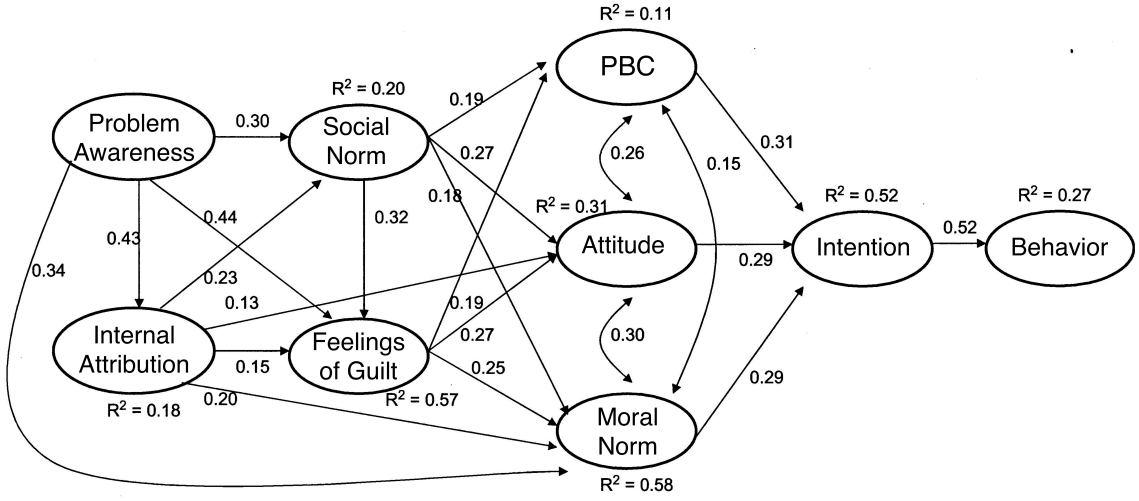

Figure 3; Bamberg & Moser's EE Model, 2007, p. 16

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intervention that would get at knowledge construction and attitude change. In the section that follows, a new model based on the literature, with a focus on one specific part of the model that is appropriate to the researcher's educational philosophy — interventions designed for knowledge gain and attitude change is presented.

A New Model

While one goal of EE is to "create new patterns of behavior of individuals, groups and society as a whole towards the environment" (Tbilisi declaration as cited in Simmons et al., 2004, p. 1), the EE literature is perpetually careful to make a distinction between education and advocacy. Some environmental educators are uncomfortable with the goal of changing behavior as an intentional outcome of education. Others are conflicted by the clear necessity for behavior change in the current crisis of consumption. These differences have implications for research as they place differential levels of focus on differing outcome variables.

Much of this debate in research purpose may be considered in light of theoretical foundations in education, such as behaviorism vs. constructivism. The basic premise of constructivism is that students build their own knowledge as opposed to being filled with the knowledge of others (Brooks & Brooks, 1999). Knowledge construction is both an individual and social pursuit, such that all students have experientially-gained conceptions of how the world works before formal education begins, and as it proceeds. Rather than a more behavioral approach, in which students are regarded as clay for teachers to sculpt (Courtney-Hall & Rogers, 2002), students are recognized instead as emerging thinkers (Brooks & Brooks, 1999). Courtney-Hall and Rogers (2002), highlight behaviorist tendencies of many PEB models saying "as an education program

focuses on promoting a certain class of behaviors conceptualized as being only tenuously linked to student knowledge and understanding, it moves out of the territory of educating students and into the territory of conditioning" (p. 285). At first glance, PEB models may seem to bring this research out of step with current constructivist educational theory, but because knowledge and attitude change are elements in this model, this criticism is simplistic. For constructivists, behavioral change is an informed and critical decision of the student, rather than an act of conditioning that disenfranchises students by attempting to translate knowledge directly into behavior. From this perspective, students should be encouraged to think critically and act responsibly, making their own decisions about what PEB is and how they will participate in their communities, even if this approach is more difficult and less effective than behavioral conditioning. Because this distinction is such an important one, measuring critical thinking and message elaboration is crucial to this model.

Perhaps using behavior to gauge the success of an educational program is a limited metric because while one thing *may* lead to the other, the potential secondary outcome is not an appropriate measure of the whole. In 1944, noted conservationist Aldo Leopold wrote: "acts of conservation without the requisite desires and skill are futile. To create these desires and skills, and the community motive, is the task of education" (Coyle, 2005, p. ii). Perhaps, knowledge and attitude change are a sound proximal goal for environmental education overall.

The model proposed to achieve PEB is the integration of the models discussed previously (see Figure 4). This model is compelling for several reasons. It is a logical

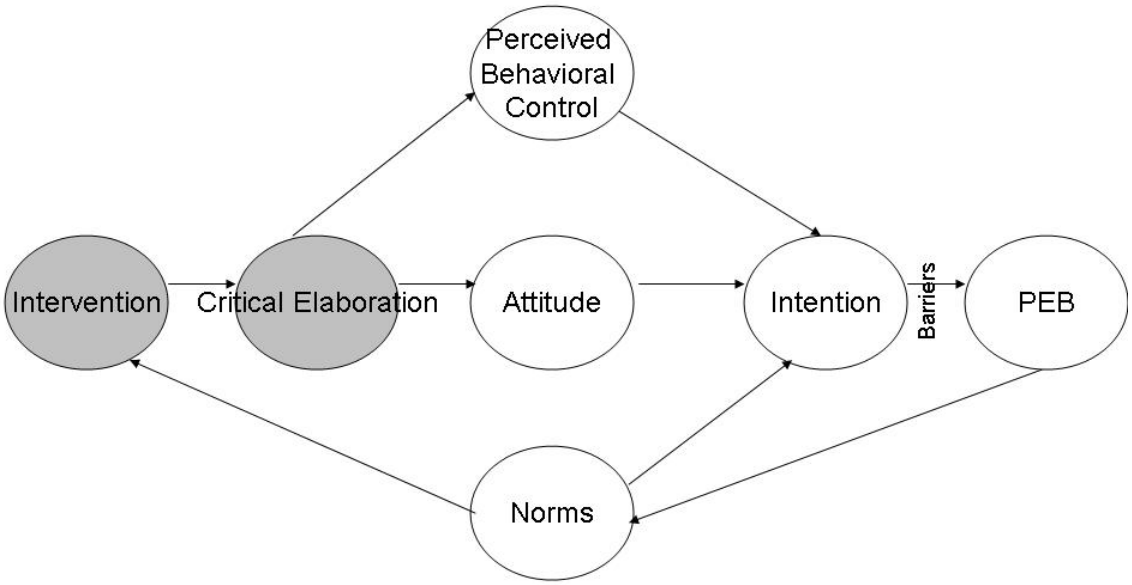

Figure 4: Proposed EE Model

synthesis of the previous models integrating theories from EE, persuasion, and social psychology. It includes important feedback loops that might attend to some of the issues with durability of interventions; that is, PEB will reinforce norms and norms will naturally reinforce the intervention. Because it implements well-respected social science theories, the measurement tools and techniques are well-considered. This model introduces an intervention to precede attitude change and perceived behavioral control using the Elaboration Likelihood Model of attitude change (Petty & Cacioppo, 1986) to provide a theoretical foundation for attitude durability, while incorporating critical thinking. Lastly, it shows that many of the elements in the model will be directly or indirectly affected by the proposed intervention. The shaded portion of this model, and intervention to affect critical elaboration, was the element measured in this study.

Conclusion

Based on the goals, known impacts, and measurement challenges of environmental education, as well as the models upon which this new approach is based, critical elaboration may provide an important construct for environmental education. Specifically, critical elaboration was designed to synthesize knowledge and attitude, variables common to all EE models, in the complex and indirect path from education to pro-environmental behavior.

Critical Elaboration

Because both knowledge and attitude are critical in reaching the goals of environmental education, critical elaboration, a construct designed for this study, offers an important new synthesis. Critical elaboration originates in research from the fields of education, from which critical thinking arose, and psychology, specifically the persuasion literature, from which elaboration arose. To understand this term and what this synthesis brings to further understanding in the environmental education field, it is necessary to first look at definitions and conceptual development of both critical thinking and elaboration. After an exploration of the histories and definitions of critical thinking and elaboration, and exploring the importance of their synthesis, I describe how these constructs have been fostered in the fields of education and persuasion and how they have been measured.

Critical Thinking

History and definitions. The inception of the idea of critical thinking is most commonly sourced to Socrates (Fasko, 2003; Kurfiss, 1988). While the term critical

thinking does not show up in the work of that time, the essence of the idea is rooted there. In *Meno*, Socrates believes that knowledge is something that resides within the individual and is drawn out through questioning observations and experiences. Said a different way, the process of reason is what draws knowledge forth. In this vignette, Socrates discusses teaching with Meno.

> I am saying that there is no teaching, but only recollection; and thus you imagine that you will involve me in a contradiction…Do you see, Meno, what advances he has made in his power of recollection? He did not know at first, and he does not know now, what is the side of a figure of eight feet: but then he thought that he knew, and answered confidently as if he knew, and had no difficulty; now he has a difficulty, and neither knows nor fancies that he knows…We have certainly, as would seem, assisted him in some degree to the discovery of the truth; and now he will wish to remedy his ignorance, but then he would have been ready to tell all the world again and again that the double space should have a double side. But do you suppose that he would ever have enquired into or learned what he fancied that he knew, though he was really ignorant of it, until he had fallen into perplexity under the idea that he did not know, and had desired to know?...And I, Meno, like what I am saying. Some things I have said of which I am not altogether confident. But that we shall be better and braver and less helpless if we think that we ought to enquire, than we should have been if we indulged in the idle fancy that there was no knowing and no use in seeking to know what we do not know;-that is a theme upon which I am ready to fight, in word and deed, to the utmost of my power. (p. 366)

Perhaps the idea that knowledge is within, while contrary to most common teaching practice today, is consistent with classical times given that the Latin word for education, *educare*, literally means to draw forth. Thus, for Socrates, critical thinking is a process of gaining knowledge through reasoning from experience.

In 1933, John Dewey discussed similar ideas, though he did not use the term critical thinking either. He used the term reflective thinking, defined as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusion to which it tends" (Dewey, 1933, p. 6). Fisher (2001) points out that Dewey's use of "support" and "conclusions"

are really the same as reason and implications, making critical reflection fit very well with Socrates's notion of critical thinking as a process of reasoning. As with Meno's slave, the reflective learner does not receive information passively, but becomes perplexed and then uses reason to fit ideas in with what is already known, with what supports these ideas and where these ideas lead. In other words, for Dewey, thinking is a very active process based on integrating information and experience in the construction of knowledge.

Among the most influential thinkers in critical thinking are Paul Glaser and Robert Ennis whose contributions helped to further define critical thinking. In 1941, Glaser defined critical thinking as "an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences, knowledge of methods of logical inquiry and reasoning, and some skill in applying those methods" (as cited in Walters, 1994, p. 8). His definition is the first which explicitly cites disposition as important, an element which is now present in many definitions of critical thinking. The scholar most frequently associated with critical thinking is Robert Ennis. He initially defined critical thinking as "the correct assessment of statements" (as cited in Kurfiss, 1988, p. 8) but more recently, he has defined it as "reflective and reasonable thinking that is focused on deciding on what to think or do" (Ennis, 1985, p. 45). For him, critical thinking is a process with specific dispositions (attitudes and inclinations) that underlie it. Interestingly, this is the first definition that includes both cognition and behavior in the use of "what to believe or to do." In this sense, his definition is troubling, since people often do not act in accordance with their beliefs (Ajzen & Fishbein, 1980). Ennis's model can be seen in Figure 5. This model

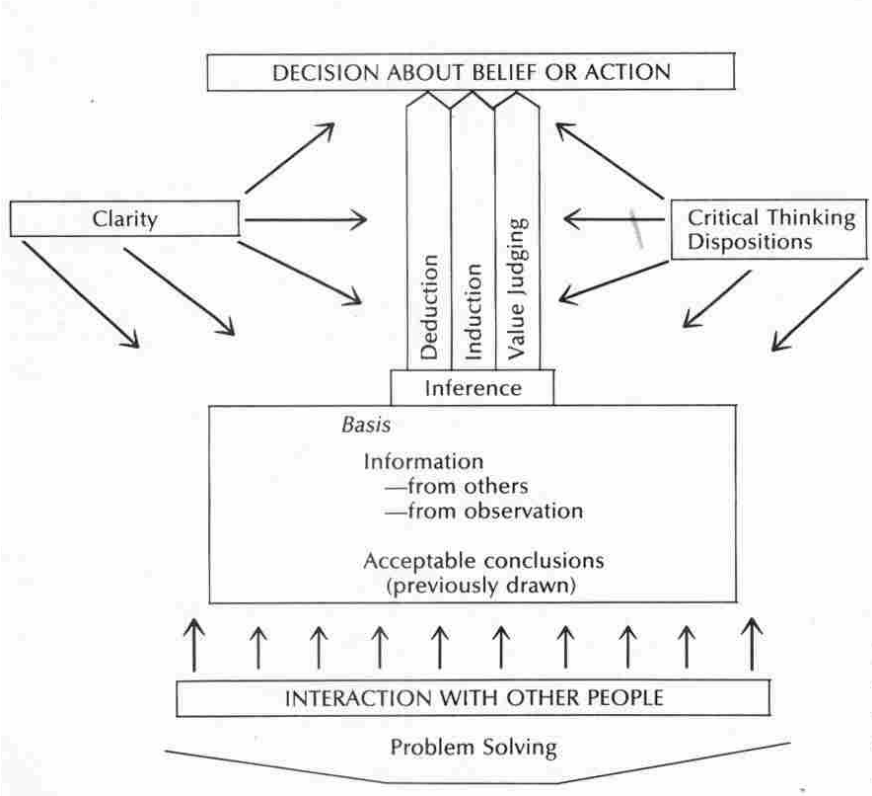

Figure 5: Critical Thinking Model: Ennis, 1985, p. 47

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indicates that dispositions are foundational to critical thinking, and that thinking is an active process based on information and conclusions from experience. From this platform, deduction, induction, and judgment occur. Further, according to this model, critical thinking shapes beliefs. Below are the dispositions and abilities that Ennis feels constitute a critical thinker.

Dispositions

1. to be clear about the intended meaning of what is said, written, or otherwise communicated
2. to determine and maintain focus on the conclusion or question
3. to take into account the total situation

4. to seek and offer reasons
5. to try to be well informed
6. to look for alternatives
7. to seek as much precision as the situation requires
8. to try to be reflectively aware of one's own basic beliefs
9. to be open-minded: consider seriously other points of view than one's own
10. to withhold judgment when the evidence and reasons are insufficient
11. to take a position (and change a position) when the evidence and reasons are sufficient to do so
12. to use one's critical thinking abilities

Abilities

1. to identify the focus: the issue, question, or conclusion
2. to analyze arguments
3. to ask and answer questions of clarification and/or challenge
4. to define terms, judge definitions, and deal with equivocation
5. to identify unstated assumptions
6. to judge the credibility of a source
7. to observe, and judge observation reports
8. to deduce, and judge deductions
9. to induce, and judge inductions
10. to make and judge value judgment
11. to consider and reason from premises, reasons, assumptions, positions, and other propositions with which one disagrees or about which one is in doubt—without

letting the disagreement or doubt interfere with one's thinking ("suppositional thinking")

12. to integrate the other abilities and dispositions in making and defending a decision

Identifying these specific dispositions and skills has led Ennis to coauthor the widely used Cornell critical thinking test and the Ennis-Weir critical thinking test, yet neither of these instruments measure dispositional attributes. They only measure skills.

With the publication of *Nation at Risk* (1983) and its findings that America's educational system was in trouble, educators looked to teaching for critical thinking as one possible solution, and as such needed a firm definition. Because such a diversity of perspectives on, and definitions of, critical thinking existed, the APA commissioned Peter Facione to work with scholars and come to a consensual definition "for the purposes of education and assessment" (Facione, 1990, p. 2). He gathered experts in philosophy, education, the social sciences, and the physical sciences (including Robert Ennis) to participate in a qualitative process to create The Delphi Report. These scholars came up with the following definition:

> We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (Facione, 1990, p. 2)

In this definition, attention is given to both skills and dispositions. The authors go on to suggest that:

> Although the language here is metaphorical, one would find the panelists to be in general accord with the view that there is a critical spirit, a probing inquisitiveness, a keenness of mind, a zealous dedication to reason, and a hunger or eagerness for reliable information which good critical thinkers possess but

> weak critical thinkers do not seem to have. As water strengthens a thirsty plant, the affective dispositions are necessary for the critical thinking skills identified to take root and to flourish in students. (Facione, 1990, p. 11)

Practical consideration of this dispositional element has caused others to suggest that perhaps critical thinking is best conceived as episodic (McCarthy, 1992) To extend the metaphor would be to say that plants are not *always* thirsty, but sometimes they do need water. This is an important distinction as it suggests that students do not necessarily develop a dispositional trait to think critically, but rather that critical thinking is a discrete activity elicited only in certain instances. This episodic interpretation also implies that critical thinking skills are present (to a greater or lesser extent) in all individuals. While there is recent dialogue about this aspect of critical thinking, it remains a minority opinion.

Understanding the history and current definitions of critical thinking is important, not only because critical thinking itself is an important goal for all educators, but more specifically because knowledge grows by linking new information to what is already known or understood, and critical thinking is the process by which that occurs (Halpern, 1996). It is worthwhile to explicitly state that critical thinking as a measure of education mandated by the authors of *A Nation at Risk* and more recently, the American Association for the Advancement of Science, calls for skills and abilities far deeper than just recall. Current education is criticized for emphasizing "the learning of answers more than the exploration of questions, memory at the expense of critical thought, bits and pieces of information instead of understandings in context, recitation over argument, reading in lieu of doing" (American Association for the Advancement of Science, 1990,

p. xvi). In this sense, measuring critical thinking plays an important role in educational assessment overall.

Elaboration

History and definitions.

Based in research in attitude change, elaboration is a construct designed to deal explicitly with exposure to persuasive messages intended to change attitudes. Early research on attitude change explored many variables including source (attractiveness and credibility), message recipient (ego-involvement), and effect of the message delivery system itself. While much data were collected, very little consistency among results existed. In fact, after several decades of attitude research, few generalizations could be made about how to change attitudes (Himmelfarb & Eagly, 1974). After a careful review of the literature, researchers (Petty & Cacioppi, 1986) began trying to integrate these conflicting results in looking at different routes to persuasion, or different ways that persuasive messages get processed. Dual-process models, including the Elaboration Likelihood Model (Petty & Cacioppi, 1986) and the Heuristic Systematic Model, (Chaiken et al. 1989 as cited in Petty & Cacioppi, 1986) have been successful in providing a theoretical framework for attitude change. These models suggest that if message receivers are neither able nor motivated, message processing will occur through a peripheral route. Peripheral cues used might include source attractiveness or mental shortcuts, called heuristics, like “dad’s usually right” (Crano & Prislin, 2006). If, on the other hand, motivation and ability are present, central route or systematic processing using elaboration will occur. The development of the Elaboration Likelihood Model gave attitude change researchers a comprehensive framework for understanding persuasion that still guides attitude research today (Petty,

Wegener, & Fabrigar, 1997). Research using this framework has shown that elaboration itself is critical because it produces attitudes that are more resistant to counter pressure, more stable, and more likely to impel behavior than those formed through peripheral cues (Petty & Cacioppi, 1986; Petty & Cacioppi, 1996).

Elaboration has been defined in many different ways in the attitude literature including the following: to systematically analyze (Crano & Prislin, 2006); to process (Tormala, Briñol, & Petty, 2007); to think about, (Fleming & Petty, 2000; Jones, Sinclair, & Courneya, 2003); an effortful, issue-relevant cognitive activity (Petty & Cacioppi, 1996); careful and thoughtful consideration of the true merits of information (Petty & Cacioppi, 1986); evaluation of arguments for a recommendation (Petty & Cacioppi, 1986); and integration [of information] into an overall position (Petty & Cacioppi, 1986). While definitions of critical thinking and elaboration are very similar, there are some important distinctions that warranted the combination of both for the purposes of this study.

The synthesis. Differences in the origins, theoretical uses, and measurement of critical thinking and elaboration suggest their synthesis will make an important contribution to research in environmental education. Both elaboration and critical thinking recognize the importance of ability yet the critical thinking literature is predominantly based in the idea that ability works in concert with disposition (Ennis, 1985; Facione, 1990) to create critical thinkers, while research in elaboration emphasizes ability that works in concert with motivation to activate elaboration (Petty & Cacioppi, 1986; Petty & Cacioppi, 1996). This seemingly subtle difference reveals a key point of divergence in critical thinking and elaboration, one that has shaped measurement of these

two constructs, and one that argues for their complementary nature in the context of EE. Critical thinking is conceived as based on a tendency, or habit of mind, whereas elaboration is conceived as something which can be activated using various techniques. Consequently, critical thinking assumes that there is a set of skills or abilities that is only possessed by critical thinkers (though there are techniques to cultivate these skills), while the elaboration likelihood model suggests that messages can be crafted to activate the motivations and abilities necessary to elaborate. Because of their different histories and baseline assumptions, their measurement has traditionally been different.

Measuring Critical Thinking and Elaboration

Critical thinking. Most critical thinking tests use a multiple choice and/or short answer format to test reasoning, argument analysis, deduction, and assumption identification. Test questions may be based on reading passages or arguments. There are more than 20 well-known general critical thinking tests and at least two subject-specific science and math tests (Ennis, 2006). All of these tests are designed to examine critical thinking as a skill except one that is designed to measure disposition. Often the disposition survey is used in combination with one of the skills exams. By and large, the format of these tests does not support the notion that critical thinking is subject-specific and seems to minimize the importance of disposition. The fact that these tests fall short of total resonance with the conceptual definitions of critical thinking, in that it is tested as episodic, makes it seem even more similar to the concept of elaboration, which is measured much differently.

Elaboration. Elaboration has been measured in four ways: self-reports, argument recall, thought-listing, and electrophysiological responses (Petty & Cacioppi, 1986).

Self-report measurements entail asking participants the extent to which they were trying to evaluate the message and /or the number of thoughts that they had pertaining to the message. Problems with this technique include participants having limited access to their own cognitive processes, and lack of ability of participants to recognize cognitive effort related to peripheral cues. Similarly, argument recall, or asking participants to list the arguments made in the message, is an imperfect measure of encoding efficacy (Petty & Cacioppi, 1996); listing the arguments may not give insight into the amount of cognitive elaboration it took to process them. The thought-listing technique is the most commonly used in elaboration measurement (Petty & Cacioppi, 1996). In this technique, students are given the following instructions after being exposed to message text:

> We are now interested in what you were thinking as you read the text just given to you. You might have had ideas all favorable to the ideas, all opposed, all irrelevant to the idea, or a mixture of all three. Any case is fine; simply list what you where thinking during the last few minutes. The next page is for you to record your thoughts. Simply write down the first idea that comes to mind in the first box, the second idea in the second box, etc. Please put only one thought or idea in a box. You should try to record only those ideas that you were thinking in the last few minutes. Please state your thoughts and ideas as concisely as possible…a phrase is sufficient. Ignore spelling, grammar, and punctuation. You will have 2.5 minutes to write your thoughts. We have deliberately provided more space than we think most people will need to ensure that everyone would have plenty of room to write the ideas they had as they were reading the text. So don't worry of you don't fill every space. Just write down whatever your thoughts were during the last few minutes. Please be completely honest and list all of the thoughts you had. (adapted from Petty & Cacioppo, 1986, p. 38)

Responses are then quantified in terms of how many issue-relevant thoughts are listed, and the profile of favorable vs. unfavorable issue-relevant thoughts.

Each of these measures alone falls short of the goal of measuring antecedents of knowledge and attitude, but their combination, using a thought-listing technique and coding for statements that show both favorable and unfavorable thoughts and evaluative

skills, such as identifying assumptions, may be valuable in structuring a measurement tool in keeping with important elements of environmental education models. For these reasons, critical elaboration was a fitting variable for this study.

Critical Elaboration Defined

For the purposes of this study, critical elaboration was defined as careful consideration of an issue characterized by thoughtful critique. Thinking skills utilized in critical elaboration include identifying unstated assumptions, questioning such assumptions, suggesting alternatives, seeking clarification and/or challenge, taking a position (and changing a position) when the evidence and reasons are sufficient to do so, looking for alternatives, and deriving an overall evaluation of, or attitude toward, the issue being presented. This construct was measured using a modified thought-listing technique.

Fostering Critical Elaboration

In light of the idea that critical thinking can be developed through education over many years and elaboration can be activated through various message techniques, it is necessary to understand what is known about fostering both processes. In this section, instructional strategies for critical thinking are discussed as are techniques for activating elaboration.

Critical thinking instructional strategies. Can critical thinking be taught and tested as a set of skills? Would these skills transfer to all disciplines? If the testing of critical thinking skills is emphasized, must they be taught, or are they inherent in solid instruction of any topic? Is it necessary to teach and test dispositions? These are the

questions that dominated the critical thinking literature in the1980s and 90s and remain unanswered today.

Four different approaches to critical thinking instruction have been debated in the literature as have specific instructional strategies. The first, termed the general approach, suggests that critical thinking is not subject-specific and can be taught independent of topic. According to Ennis, (1989) who advocates this general approach, conceiving of critical thinking as subject-specific is akin to suggesting that when *"*we write or speak*,* we are writing or speaking about something*,* [and thus] there can be no teaching of general writing or speaking skills " (1996 p. 6). Others (Glaser, 1985; Resnick, 1987) advocate the infusion approach —that critical thinking skills are taught and made explicit within a certain subject matter. For instance, in teaching ecology, an instructor would not only model critical thinking, but also teach the general skills and dispositions of critical thinking within deep instruction of the concepts and processes of ecology. This context is necessary because in order to think critically about something, students must have the content knowledge and familiarity with the language of the discipline. The immersion approach is "instruction in which students do get deeply immersed in the subject" but the teaching of critical thinking skills themselves is not necessary (McPeck, 1981 as cited in Ennis, 1989, p. 5). Lastly, there is a mixed approach in which critical thinking skills are taught explicitly, but separately from the subject matter. This approach finds support from Ennis (1985), Sternberg (1987), Nickerson (1988), and Perkins and Salomon (1989) as cited in Ennis 1989. These larger approaches aside, specific strategies for instruction have also been proposed. A 1988 report to the Association for the Study of Higher

Education suggests that there are there are five key strategies to foster critical thinking which include the following:

1. Start with a problem and link it to a context with which students are familiar (i.e., use inquiry)
2. Teach modeling, coaching, reasoning skills, and explain when and how to use them
3. Use metacognitive prompts
4. Understand and challenge misconceptions
5. Motivate students with cognitive and social strategies. (Kurfiss, 1988)

Additionally, this report encourages educators to integrate students' personal concerns in teaching and have students take the point of views of others (Kurfiss, 1988).

Fostering elaboration. With both ability and motivation identified as important factors, fostering elaboration involves both message content and context. Many studies have manipulated the message content, frame, and style of delivery to explore the effects of these changes on elaboration. Context, or environmental factors, can also be designed to maximize elaboration likelihood. In this section, relevant studies are discussed.

To foster elaboration, Petty and Cacioppi (1986) suggest several important variables including message complexity, environmental distractions, argument quality, and even body posture. Messages that are either complex or not comprehensive tend to deter ability for elaboration. Distractions or message disruptions affect ability to elaborate such that strong arguments are not accepted as they would be without distraction and weak arguments are not rejected as they would be without distraction. Strong arguments are ones "containing arguments such that when subjects are instructed

to think about the message, the thoughts that they generate are predominantly favorable" (Petty & Cacioppi, 1986, p. 32), whereas weak messages are only "ostensibly in favor of the advocacy." The arguments in weak messages are such that when subjects are instructed to think about them, the thoughts that they generate are predominantly unfavorable" (Petty & Cacioppi, 1986, p. 32). Other studies suggest that body posture and heart rate can play a role in ability to elaborate.

In terms of motivation to elaborate, dozens of factors have been identified including need for cognition (Petty & Cacioppi, 1986), involvement (Johnson & Eagly, 1989), message source (Petty et al., 1997; Priester & Petty, 2003), language (Areni, 2003; Areni, Ferrell, & Wilcox, 2000; Areni & Sparks, 2005), forewarning (Petty et al., 1997), group discussions (Werner, White, Byerly, & Stoll, 2009), validation (Werner, Stoll, Birch, & White, 2002), cognitive consistency (Petty & Cacioppi, 1996), and message framing. Because this study was based on motivation to elaborate (and sampling dealt with ability to elaborate), it is necessary to understand the impact of many of these variables and how they argue for the strength of the message frame under study. Specifically, in this section, need for cognition, cognitive consistency, involvement, message framing, and language are discussed.

Need for cognition is the only recognized intrinsic motivation for elaboration. The need for cognition is described by Petty and Cacioppi (1982) as the statistical tendency of, and intrinsic enjoyment individuals derive from, engaging in effortful cognitive activities. Largely based on the idea that humans do not possess unlimited energy for effortful problem-solving, those low in need for cognition are described as

cognitive misers. This distinction provides a way to assess chronic individual differences in elaboration likelihood.

Cognitive congruency theories are based on the idea that humans have mental organizing systems, or schemata, that allow them to see the world as somewhat stable and predictable. These systems are networked cognitions, or thoughts, and it is important that balance and congruence in these cognitions be maintained. Thus, information or persuasive messages are considered in light of cognitive networks into which they might fit (Petty & Cacioppi, 1996). Consistency theories suggest that this congruence in light of new information is so important that maintaining consistency provides motivation to elaborate. Cognitive dissonance theory (Festinger, 1957) is the most popular of these cognitive congruence theories and suggests that maintaining consistency is not as straightforward as might be anticipated. When presented with information that disconfirms salient beliefs, people will find a way to make this information consistent with their beliefs in one of three ways. They will either: 1) reject new information and strengthen their own ideas by rehearsing entrenched thoughts and generating counter-arguments; 2) minimize the importance of the information such that the inconsistencies become too unimportant to expend limited cognitive energy; or 3) change their attitudes and underlying beliefs (Petty & Cacioppi, 1996). How exactly they choose to maintain consistency is in itself a critically important factor for cognitive elaboration, and here involvement plays a role.

A meta-analysis of involvement in the persuasion literature sorts involvement into three distinct categories: Value-Relevant, Impression-Relevant, and Outcome-Relevant (Johnson & Eagly, 1989). Value-relevant involvement includes messages that are

aligned with the recipient's self-concept and values. Value-relevant messages tap into ideas that are very important to the recipient, ideas that may be a part of one's ego. For example, marathon runners are likely to consider running as a part of their identity. As such, messages about running are likely to be value-relevant to them. Similarly, prior experience with the topic of a message increases elaboration because people are more able to critique message content. Outcome-relevant involvement describes messages that relate directly to the participant's experiences and/or goals. For example, studies were conducted on college campuses in which messages suggested making comprehensive exams mandatory in a time frame that would affect students' experiences directly, elicited a high outcome involvement. Conversely, similar messages about comprehensive exams were given to students such that students at another college would be affected rather than themselves, creating a low involvement condition. Finally, impression-relevant involvement is based on self-presentational ideas or the impression one makes on others "holding an opinion that is socially acceptable to potential evaluators" (Johnson & Eagly, 1989, p. 292) such that reactions to messages that will be seen or evaluated will often be centrist rather than extreme positions to better manage impressions.

Involvement as a multidimensional construct along these three lines was supported by content validity data (McCarty, 2005), which further suggested:

> each type of involvement has a different pattern of relationships with other variables. For example, because impression-relevant involvement was the only type of involvement that was consistently associated positively with other directedness, it is distinguishable from value- and outcome-relevant involvement. Furthermore, outcome-relevant involvement is distinguished from the other types of involvement by its strong association with information seeking. Although value-relevant involvement was also associated with information seeking for some topics, these effects were inconsistent and less substantial than those for outcome-relevant involvement. Finally, value-relevant involvement is

> differentiated from impression-relevant involvement because of its substantial relationship with attitude extremity. (p. 256)

Fostering involvement is key to increasing critical elaboration.

An understanding that knowledge and attitude are both crucial to fostering pro-environmental behavior suggests that critical elaboration will be a valuable construct in the context of environmental education. Using techniques to foster critical thinking and central route processing will enable educators to attend to critical elements of both knowledge and attitude. These techniques include making topics relevant, challenging misconceptions, and using messages designed to foster involvement and cognitive dissonance have the potential to play an important role in this task.

Framing

Through framing, the intentional use of words and metaphor to facilitate and shape understanding, instructional interventions can be created that may facilitate reaching the goals of environmental education. Given the workings of schema theory, frames that integrate differing levels of involvement, dissonance, and relevance should promote critical elaboration. In this section, after a brief description of the definition and history of framing and its theoretical underpinnings in schema theory, the traditional frames used in EE are considered as are the reasons that changing frames is likely to foster critical elaboration. Finally, parameters for the creation of new frames to impact critical elaboration are defined.

Definition and Theoretical Basis

Frames were initially conceived as internal cognitive structures that organize the way people think (Carroll, 1956; Derry, 1996; Lakoff, 2004). While this conception of

framing still dominates much of the literature in cognitive science and education, an alternate conception of framing as a set of external, socially-constructed ideas also has a strong presence, particularly in the fields of communication, anthropology, and political science. Whether considered an internal cognitive construction or a set of understandings informed by cultural practices, frames have been shown to be powerful tools for understanding.

Cognitive perspective on framing. Cognitive scientists describe frames as "the mental structures that shape the way we see the world" (Lakoff, 2004, p. xv). People cannot consciously access frames because they are part of the cognitive unconscious, but, "when you hear a word, its frame is activated in your brain" (Lakoff, 2004, p. xv). In this sense, frames can be interpreted as individual organizing structures for new information and knowledge.

Education researchers label these cognitive structures of the mind schemata and find these structures useful in understanding how comprehension works. Piaget described the learning process as one where these schemata grow and change with experience (Martin, 1999). Similarly, Brewer and Nakamura (1984), described schemata as "higher-order cognitive structures that have been hypothesized to underlie many aspects of human knowledge and skill" and further suggested that "they serve a crucial role in providing an account of how old knowledge interacts with new knowledge in perception, language, thought, and memory" (as cited in McVee, Dunsmore, & Gavelek, 2005, p. 537). Rumelhart and Ortony (1977) describe how schemata organize memory in defining schemata as "data structures for representing the generic concepts stored in memory [that exist for] generalized concepts underlying objects, situations, events,

sequences of events, actions, and sequences of actions" (as cited in McVee et al., 2005, p. 536). Finally, Anderson and Pearson (1984) more specifically describe the function of schemata in reading as "a structure that facilitates planful retrieval of text information from memory and permits reconstruction of elements that were not learned or have been forgotten" (as cited in McVee et al., 2005, p. 537). For example, students with different interests were given passages to read such as the following:

> Rocky slowly got up from the mat, planning his escape. He hesitated a moment and thought. Things were not going well. What bothered him most was being held, especially since the charge against him had been weak. He considered the present situation. The lock that held him was strong, but he thought he could break it. He knew, however, that his timing would have to be perfect. Rocky was aware that it was because of his early roughness that he had been penalized so severely—much too severely from his point of view. The situation was becoming frustrating; the pressure had been grinding on him for too long. He was being ridden unmercifully. Rocky was getting angry now. He felt he was ready to make his move. He knew that his success or failure would depend on what he did in the next few seconds. (Anderson et al., 1977, p. 372)

This passage can be interpreted as either a wrestling match, or a prison break. As hypothesized and shown through the completion of disambiguation multiple choice tests, the students' backgrounds were predictive of their interpretation of the passage (Anderson et al., 1977). Further, more than 80% of these students had no awareness of the alternative perspective while reading. These data suggest that "high-level schemata provide the interpretative framework for comprehending discourse" (Anderson et al., 1977, p. 367). Similarly, in reading letters about an Indian and American wedding, citizens read passages about their native home more quickly, recalled more information from native passages, and produced less distortion of native passages (Steffensen, Joag-Dev, & Anderson, 1979). Finally, 4-year-old children when asked to remember and reconstruct the layout of a model kitchen, added things from their own experience of a

kitchen, rather than using only the items in the model kitchen they had seen (Blades & Banham, 1990). For education theorists, schemata are a critical part of how knowledge is stored in and accessed from memory. This process of storage and retrieval shapes new understanding. In looking at the characteristics of schemata, Anderson clarifies this point and emphasizes the dynamic nature of schemata in saying:

- Schemata are organized meaningfully, can be added to, and, as an individual gains experience, develop to include more variables and more specificity.
- Each schema is embedded in other schemata and itself contains subschema.
- Schemata change moment by moment as information is received.
- They may also be reorganized when incoming data reveal a need to restructure the concept.
- "The mental representations used during perception and comprehension, and which evolve as a result of these processes, combine to form a whole which is greater than the sum of its parts." (1977, pp. 418-419)

From this list of characteristics, schemata are understood as largely individual and internal, shaped by experience. While cognitive researchers and educational scholars underscore the importance of the individual nature of these mental structures, others suggest that language and culture play an inescapably important role in meaning making.

Sociocultural perspectives on framing. Sociocultural perspectives are described as "the belief that thought has its genesis in social interaction [i.e., schemata include] both externally focused, interpsychological tools, such as language and other sign systems, and internally focused, intrapsychological tools, such as thought (McVee et al., 2005, p. 532)." Further schemata are "created, shaped, and sustained in social and cultural contexts" (McVee et al., 2005, p. 532). This perspective suggests that schemata are necessarily beyond individuals given that everything is socially constructed and exists within the parameters of language.

Sociologists describe the importance of frames and effectively bridge the gap between schemata and frames. Goffman (1974), for example in discussing what he calls primary frameworks, suggests:

> It seems that we can hardly glance at anything without applying a primary framework, thereby forming conjectures as to what occurred before and expectations of what is likely to happen now. (p. 38)

This line of thinking suggests that frames may function to both organize experience and guide action (Benford & Snow, 2000). Collective action frames focus on this element specifically, because they are not "merely aggregations of individual attitudes and perceptions but also the outcome of negotiating shared meaning" (Gamson, 1992, p. 111). Benford and Snow clarify the role of schema and frames in saying:

> The implied distinction between schemas and frames can be stated more concretely by thinking of schemas as 'participants' expectations about people, objects, events, and settings in the world, as distinguished from alignments being negotiated in particular interaction,' which is what frames do (Tannen & Wallat 1993:60). Frames and schemas interact during the course of interaction between two or more individuals, with frames providing an interpretive 'footing' that aligns schemas that participants to the interaction bring with them. Thus, frames and schemas are not different concepts for the same phenomena but are highly interactive, with frames constituting a broader, interpretive answer or definition to 'what is going on' or 'what should be going on.' (p. 614)

This suggests that an important feature for sociologists, frames, usually discussed as merely organizing structures for cognitive scientists and educators, are a product of negotiated shared meaning. Frames provide an "interpretive footing" to activate a participant's own schemata.

The idea that meaning is negotiated, and that the particular language educators use influences how students think about reality was borne out of a study of language in diverse cultures. Lucy (1997) describes two key features of linguistic relativity that "language embodies an interpretation of reality, and language can influence thought

about that reality" (p. 294). These features render language culturally and individually subjective rather than universal and objective. Linguistic relativity is often credited to linguistic anthropologists Edwin Sapir and Benjamin Whorf. According to Whorf, who studied Hopi, Maya, and Aztec cultures:

> Formulation of ideas is not an independent process, strictly rational in the old sense, but it is of a particular grammar, and differs, from slightly to greatly between different grammars. We dissect nature along lines laid down by our native languages. The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds-and this means largely by the linguistic system in our minds. We cut up nature, organize it into concepts, and ascribe significance as we do, largely because we are parties to an agreement to organize it in this way-an agreement that holds throughout our speech community and is codified in the patterns of our language. The agreement is, of course, an implicit and unstated one, *but its terms are absolutely obligatory*; we cannot talk at all except by subscribing to the organization and classification of data which the agreement decrees. (Carroll, 1956, pp. 212-213)

For Whorf, framing is not simply a matter of word selection, but rather the pattern of language itself that affects both how people think and how people articulate ideas. Further, both Whorf and Sapir subscribed to linguistic determinism, meaning that language and thought influence each other such that language is not a mirror of culture alone, but also, through reciprocal influence, a shaper of culture.

Vygotsky, shares this perspective explaining, "the sense of a word . . . is the sum of all the psychological events aroused in our consciousness by the word. It is a dynamic, fluid, complex whole…"(1986, pp. 244-245). In this sense, language can never be neutral or simple. All language is imbued with our own psychology nested within a larger cultural landscape bounded by language. Said a different way, "meaning does not exist in the form of words or even images, but within relationships among and across experiences, actions, talk, people, and all sorts of culturally situated knowledge (Gee,

2004 as cited in McVee et al., 2005, p. 546). This conceptualization is foundational in other disciplines as well.

Media frames, for example, are described as "a central organizing idea or story line that provides meaning to an unfolding strip of events" (Scheufele, 1999, p. 106). Because people make sense of information in three ways, "through peer interaction, personal experience, and interpreted selections from the mass media" (Neuman et al., 1992, p. 120 as cited in Scheufele, 1999), these frames play an important role in how people conceive of information by what schema they activate. Similarly, for political science scholars, "framing refers to the process by which people develop a particular conceptualization of an issue or reorient their thinking about an issue" (Chong & Druckman, 2007, p. 104). Consider this example: "when asked if they would favor or oppose a hate group holding a political rally, 85% of the respondents answered in favor if the question was prefaced with the suggestion 'Given the importance of free speech,' whereas only 45% were in favor when the question was prefaced with the phrase, "Given the risk of violence" (Sniderman & Theriault, 2004 as cited in Chong & Druckman, 2007, p. 104). The frames used in these two examples tap into entirely different personal metaphors (i.e., "rally as free speech" vs. "rally as violent protest") and their corresponding schemata. This example fits well with Lakoff's sentiment that "Framing is about getting words that fit your worldview, it's not just language. The ideas are primary and the language carries those ideas, evokes those ideas …words can draw you into someone else's worldview" (Lakoff, 2004, p. 4). Lakoff also suggests that if a strongly held frame does not fit the facts, the facts will be ignored while frames will remain intact (Lakoff, 2004).

Cultural metaphor and framing. Finally, frames may operate at a more subconscious level than in the example described above. Lakoff suggests that metaphor and analogy embedded in frames are powerful in helping us to make sense of new ideas and fit them into individual mental maps more readily. As an ingrained way of thinking, these metaphors come to be taken literally (Lakoff & Johnson, 1980). For example, the language used to describe "argument" effectively elicits a war metaphor:

> Claims are *indefensible*.
> He *attacked every weak point* in my argument.
> His criticisms were *right on target.*
> He *shot down* all my arguments. (Lakoff & Johnson, 1980, p. 4)

Lakoff and Johnson suggest that people might think and act differently if a language that would activate a dance metaphor was used to frame "argument." In this example, frames are operating on a more subtle, but potentially no less powerful level than those described by political scientists (Chong & Druckman, 2007). Metaphorical frames seem particularly effective in shaping not only how one understands "argument" but also how one feels about it. This happens by activating a certain set of schemata. Because humans think using an "extensive, but unconscious, system of metaphorical concepts" (Lakoff, 1995, p. 177) and language activates these metaphors, metaphors are especially powerful for learners and can effectively challenge existing paradigms (Gellat & Gellat, 2003; Wells, 2006).

Metaphor in Environmental/Ecological Education

Because ecology is often antithetical to cultural metaphors, activating alternative schemata may be critical in an EE context. Ecological literacy entails "thinking broadly, to know something of what is hitched to what" and "is not [only] comprehension of how

the world works, but in light of that knowledge a life lived accordingly" (Orr, 1992, p. 87). Yet, exploration of common misconceptions and of commonly used textbooks suggests that both language itself and cultural metaphor embedded in that language disguise relationships fundamental to ecological literacy and discourage thinking broadly about the role of humans in ecological systems.

Pedagogical language and textbooks can either reinforce or challenge common cultural conceptions that are contrary to ecological reality and often misappropriated metaphor creates and reinforces ecological misconceptions (Chew & Laubichler, 2003). Cultural conceptions of ecology are rife with misunderstandings. The topics of these misconceptions, including matter cycling, energy flow, and natural selection have been widely studied (Armstrong, 1997; Griffiths & Grant, 1985; Hellden, 1995; Munson, 1994; Smith & Anderson, 1986). For example, matter cycling is narrowly understood among students who commonly believe that matter is created and destroyed in biological processes (Smith & Anderson, 1986). Look up "matter" in *Roget's Thesaurus* and you get "stuff, substance, and material," a fair representation of students' initial conceptions. It is important to note there is no logical distinction between "matter" and "natural resources." If people were able to create matter, people would live in a world of unlimited natural resources; if people were able to destroy matter, then producing disposable items would not be the ecological liability it is now. Evolution and natural selection also provide examples of misunderstood concepts. Two common misconceptions are that evolution is somehow directed and not random, and that people are able to individually adapt to meet needs. Either misconception undermines reasons for conservation because individuals who can immediately adapt to any challenge or

shortage need not engage in conservation. Similarly, students often understand natural selection as "the biggest and strongest survive" (Munson, 1994), an idea that fits the culturally normative conception that "bigger is better" despite the fact that this is not how natural selection works. Survival of the fittest, perverted from Darwin's ideas about natural selection, has been applied to economic systems to justify unethical and unsustainable economic practices and is persistently reinforced in culture (Spencer, 1864). It is worth considering how the frame "survival of the fit-ins" would activate different schemata thus facilitating a different understanding, changing the base metaphor from competition to cooperation (Montague, 2006). Language that shifts the emphasis from competition to cooperation in fact provides a more ecologically grounded perspective (Margulis & Sagan, 1986) and might, through activating critical elaboration, facilitate a more realistic understanding. In this sense, language based on alternative metaphors may serve to decrease student misconceptions.

Traditional metaphors and themes in the language of commonly used textbooks tends to resist ecological realities, fundamentally separating humans from the rest of nature, and this continued resistance is based on the metaphorical concept of humans as apart from nature rather than a part of nature. For example, in the introductions of three of the most commonly used introductory ecology textbooks, authors use both direct statements and implicit metaphor to express perceptions about humans and nature. Begon, Townsend, and Harper (2006) state, "we try to conserve biodiversity to maintain ecosystem 'services'…" and further, "our ability to control and exploit ecosystems cannot fail to be improved by an ability to explain and understand" (2006, p. xii). Molles Jr. (2008) explains that humans are changing the environment without understanding the

consequences of these changes and that it is the role of ecologists to solve this problem. Ricklefs states "where we humans fit in a less than perfect world is a judgment that each of you must make, guided by your own sense of values and moral beliefs" (2007, p. 1). He goes on to suggest that an understanding of how systems work and the "ways in which humans are a part of the natural world" may inform this decision. Metaphors separating humans and nature are reinforced in all of these introductions and as a consequence, activate different schemata. Similarly, the initial chapter of a very popular environmental studies text (Miller, 1997) is an overview of humans and nature. Information is often attributed to "analysts" or "scientists." For example, "some analysts…contend that the world is not overpopulated…people are our most important resource ―both as consumers and producers …" followed by "leading scientists believe that we are depleting and degrading the earth's natural capital at an accelerating rate as our demands on the earth's resources and natural processes increase exponentially" (p. 20). The commonality among all of these texts is that, implicitly or explicitly, humans are depicted as *apart from* rather than *a part of* nature. This fundamental metaphorical split is not only antithetical to deep ecological literacy, but also serves to make ecology less relevant for students. Consider as an alternative the embedding of humans in a system, as explicitly dependent on the ecosystem like every other animal. This approach is more in keeping with ecological literacy and including a more integrative approach may be critical if students are to see themselves as part of a larger system.

The consistently expressed divide between humans and nature is indicative of the fundamental problem in the metaphors that consumer societies live by. These texts, in keeping with traditional metaphor, perpetuate the perception of "humans as apart from

nature" and these metaphors play a powerful role not only in shaping the synthesis and interpretation of ecological information, but perhaps in motivation for students to critically elaborate on messages about ecology. While students can attain an academic understanding that humans are included in natural systems, language and metaphor may inhibit students from consistently internalizing this knowledge through critical elaboration. "This is significant because if we humans consider ourselves apart from nature, we will not necessarily consider ourselves subject to nature's laws" (Cachelin et al., 2010, p. 671) and will not necessarily be motivated to consider ecological realities that can shape behaviors and decision-making.

Compare this to Garrett Hardin's approach to the articulation of ecology, "we can never merely do one thing" (Hardin, 1985, p. 24). This approach necessitates a consideration of the consequences of all of our actions, (i.e. asking "what then)" (1985). This very question illustrates an understanding of the inseparable relationships in ecological systems and asking "what then" mandates our involvement in issues beyond ourselves. Framing ecology such that students are encouraged to ask "what then?" about their role in a system with limited resources, governed by the laws of thermodynamics, lends itself more to student involvement. As a culture, we are not encouraged to recognize feedback loops in ecosystems and our language practice perpetuates the idea that people exist outside of the rules of ecology. When pedagogical language reinforces common misconceptions rather than eliciting conceptual change, and distances us from the subject matter, making it less relevant to our own experience educators undermine their goals because existing schemata, right or wrong, place powerful limits on the assimilation of new information (Ausubel, 1968).

Finally, research about framing messages to elicit PEB has been variously identified as altruistic or self-interested (Corbett 2005; Kaplan, 2000; Schultz & Zelezny, 2003). Kaplan (2000) argues that contextualizing PEB as altruistic unintentionally communicates that environmentalism requires personal sacrifice. Further, he suggests that this approach is "far from helpful" and undermines potentially powerful linkages with critiques of materialism as unhealthy and unsatisfying..." (p. 495). Thus it has been suggested that self-interested frames in Western culture will be more effective and activate existing self-interest norms (Corbett 2005; Kaplan, 2000; Schultz & Zelezny, 2003). This research fits with the metaphor of humans as a part of nature because this metaphor is congruent with a self-interested rather than an altruistic approach.

Voice in Environmental/Ecological Education

Syntax may also play an important role in students' perceptions of their involvement in nature. Language used around ecological concepts contextualizes them, often serving to distance us from the systems people depend on for life. Relegating issues to the category "environmental" separates us from them in a way that consideration of them from a social issues or health perspective would not. This creates a perception that the environment is a special interest rather than a system upon which all depend and of which are a part (Shellenberger & Nordhaus, 2005). This decontextualization can impede critical thinking and dull awareness of the consequences of actions and feelings of responsibility by undermining the relevance and involvement necessary for critical elaboration.

Abstract concepts are often explored using passive voice as opposed to the more empowering active voice. Concepts like habitat loss, biodiversity, population

growth, over-consumption, and introduced species are central to the current study of ecology and are all complex concepts. Confusingly, many texts use these concepts as either the passive subject or the object of the sentence, meaning that there is no concrete actor. For example, consider the text that follows:

> Bengal tigers once roamed widely across India and Southeast Asia. Now they're in trouble because of habitat loss and people killing them illegally for their bones, which are used to make traditional Asian medicines. (Braus, 1994, p. 7, as cited in Chenhansa & Schleppegrell, 1998)

Two causes of population decline are identified in the text above, yet, 90% of middle school students understood this to mean that people killing the tiger was the major cause of decline (Chenhansa & Schleppegrell, 1998). It is not only the complexity of the concepts, but also the use of passive voice that students find confusing, and it is logical to assume that passive voice and content both play a role in how new information is integrated into existing schemata.

Passive voice is often used in the presentation of research, which can also impact how humans see themselves in ecological terms. For example:

> Some Soviet scientists researching the Bering Sea call American scientists "anti-ecologistic" because of American emphasis on studying single species…We see everything in terms of connections.
> …Scientists wonder what is happening to seals, sea lions, and birds. … we watch sea lions eating seal pups with greater frequency than ever in memory…chicks on bird cliffs dropping to the rocks below because they are too weak…seal pelts are thinner than ever in memory…mature bull seals are smaller than just ten years ago. This tells us that all these species are having food problems…Every coastal village where there is strong dependency on the sea for a livelihood and a way of life have their own observations. (Knudtson & Suzuki as cited in Smith & Williams, 1999, pp. 120-121)

The text of the Aleutian observer is first person active voice. From both language content and his chosen voice, he is an active member of the community. This element may in fact be key to perceived involvement and relevance.

Intentional framing, which includes both the obvious use of metaphor and active voice, is particularly important in an environmental education context for several reasons. First, ecological concepts are often antithetical to commonly used cultural metaphor, leading to a variety of misconceptions. Second, common cultural metaphors that activate a schema of humans as apart from nature, rather than a part of nature, will most likely decrease both involvement and relevance such that elaboration is less likely to occur. Third, traditional frames do not create dissonance, which according to the Elaboration Likelihood Model, can provide motivation to elaborate. Finally, the use of passive voice, and the perception of nature as object rather than subject, may decrease ecological understandings as well as student involvement and relevance. Because the distal goal of EE is pro-environmental behavior, and both attitude and understanding play important roles in fostering such behavior, using frames with active voice that include humans as a part of the natural system may be significant.

The difficult, if hopeful, work lies ahead in crafting and implementing frames based on new metaphors. Teaching for ecological literacy is demanding to be sure, and inevitably leads to uncomfortable self-examination. Orr (1992) notes:

> …to see things in their wholeness is politically threatening. To understand that our manner of living… is linked to cancer rates in migrant laborers in California, disappearance of tropical rainforests, 50,000 toxic dumps across the U.S.A., and the depletion of the ozone layer is to see the need for a change in our way of life. (p. 88)

This type of dissonance may be precisely the approach needed to increase student involvement and critically elaborate on ideas that would change culturally enforced schemata.

Conclusion

The purpose of this study was to consider the impacts of intentional framing on critical elaboration. Environmental education models suggest that interventions seeking to impact both understanding and attitude are crucial. To this end, critical elaboration, a synthesis of critical thinking from the education literature, and elaboration, an attitude-related construct from the persuasion literature, is an important contribution to the field of sustainability education. According to the elaboration likelihood model, involvement and dissonance foster critical elaboration. Similarly, according to critical thinking research, critical thought is more likely to occur when information provided is relevant to students. Yet, traditional teaching often uses frames that discourage involvement, relevance, and dissonance and as such decrease the likelihood that critical elaboration will occur. Alternative frames that manipulate underlying metaphor and voice may be able to change this pattern and activate different schemata that could increase critical elaboration. To test these ideas, frames were developed and tested.

Active systems frames (ASF) may clarify existing misconceptions that occur due to language use, and counter the variety of cultural messages that initially undermine message elaboration and ultimately undermine PEB. For the purposes of this research, an ASF was defined as one that takes a systems-approach to the environment — using the base metaphor that humans are *a part of* rather than *apart from* ecosystems, and uses active rather than passive voice. For example, teaching students that "we are all solar-powered," a notion which encompasses these criteria, may be more meaningful and drive home a more personal conceptualization of the realities of energy flow than discussing the laws of thermodynamics. Similarly, teaching students that there is no "away" to

which to throw things, by reinforcing that people are part of a system in which they drive waste materials to a landfill, may provide the much needed impetus for message elaboration that might ultimately result in conservation. With language being constitutive of reality, as much as reflective of it, ASFs may provide a deeper and more lasting critical understanding of ecology while also attending to issues of attitude, personal and social norms, and perceived behavioral control. Therefore, this study included three hypotheses:

> H_1: There will be a significant interaction between metaphor type and voice. The interaction will be such that the effect of voice on critical elaboration will depend on the metaphor being used. Active voice and the integration (a part of nature) frame will yield the highest critical elaboration scores.
> Should the interaction be nonsignificant, main effect hypotheses will be tested.
> H_2: Critical elaboration scores will be higher for active voice than for passive voice.
> H_3: Critical elaboration scores will be higher for systems metaphors than nonsystems metaphors

CHAPTER III

METHODS

The purpose of this study was to examine the effect of framing in the context of environmental education. This chapter describes the methods employed to investigate this purpose. The organization of the chapter includes seven main sections: 1) setting, 2) participants, 3) research design, 4) measurement, 5) procedures, 6) data analysis, and 7) threats to making valid inference.

Setting

Data collection took place on the University of Utah campus in an introductory level Parks, Recreation, and Tourism (PRT) course and on the Utah State University campus in an introductory level ecology course. Between 75 and 100 students were registered for the courses from which research participants were drawn. Data were collected during a regular classroom meeting; in one class, this happened at the beginning of the session, in the other, at the end. Both of these classes took place midmorning. While classes maintained the atmosphere of an exam, there were some distractions for students. For example, in one class, students had computers out and were circulating a sign-up sheet during data collection.

Participants

The sample consisted of 70 introductory Parks, Recreation, and Tourism students from the University of Utah and 68 ecology students from Utah State University. The collective sample of participants represented a variety of academic majors including many who had not yet declared a major. Students from these courses were appropriate for this study for several reasons. Introductory courses typically offer a diversity of students and a large sample size. Introductory courses likely mean that students have not yet been exposed to a lot of university-level coursework in this area. Petty and Cacioppi (1986) report that little prior knowledge of an issue means that participants need to rely on the information in the provided text. As such, a class with students who are less familiar with ecological concepts may yield responses based solely on the stimulus. All participants read a consent form prior to their involvement in the study.

Measurement

Thought-Listing Technique

Critical elaboration was measured using an adapted thought-listing technique (Brock, 1967; Greenwald, 1968 as cited in Petty & Cacioppi, 1981). This approach emphasizes "how people personally evaluate the information provided…and ultimately it is the person's own self-statements that produce change or resistance" (Petty & Cacioppi, 1981, p. 310). This measure, usually used in studying the impact of a persuasive message on attitude, provides a format through which participants can respond to messages. Given text, instructions (see Appendix A), and typically 2-3 minutes to list thoughts, participants simply read text and record their thoughts in written statements. Response time is limited to increase the likelihood that recorded responses are only those elicited

by the text. Times have ranged between 2 and 45 minutes and the general rule of thumb is "if only the most salient thoughts are desired, then a brief interval would be better than a long one. If the interval is too long, a subject would have time to reflect on, generate additions to, select among, and delete portions of his or her cognitive responses" (Petty & Cacioppi, 1981, p. 316). Because this study measured critical thinking as an element of critical elaboration, and due to the length of the text, the time was expanded 15 minutes.

Coding for Critical Elaboration

In previous thought-listing studies, researchers coded participant statements along predetermined dimensions including polarity, target, origin, or reality. For example, the polarity dimension would include an assessment of whether the statement reflects a positive, neutral, or negative attitude toward the attitude object. In this study, rather than coding for positive or negative statements toward and attitude object, statements were coded as to whether or not they exhibited critical thinking. Critical thinking was defined by the presence or absence of four indicators (identifying/questioning unstated assumptions; looking for alternatives/suggesting an action; seeking clarification and/or challenge; and deriving an overall evaluation of, or attitude toward, the issue being presented). Any one of these indicators meant that the listed thought was an example of critical elaboration as described in the coding definitions (see Appendix B). These definitions were the basis of the codebook.

The purpose of developing the codebook was to produce a document that would enable coders for this study to systematically identify examples of critical elaboration from a list of thoughts. In addition, the codebook would enable future researchers to replicate this study. Four main elements of critical elaboration were identified from the

literature on critical thinking and elaboration and then decision rules and operational definitions were created for each element.

Development of the codebook was a lengthy process consisting of several phases. Throughout the summer of 2010, two student codebook developers and the researcher worked through pilot data to refine definitions, the data collection form, and protocols. Although scoring for critical elaboration was based on meeting only one of the four defined elements (identifying unstated assumptions, seeking clarification, presenting alternatives, or expressing an attitude) data were coded for the specific element to ensure clear and useful definitions. Developers initially worked from broad definitions with several criteria and refined both definitions and decision rules until at least two people agreed on codes more than 90% of the time. Examples of some of the issues that arose were:

- What constitutes a thought?
- How do we code emotion-based statements?
- If a statement is related to one's self, does that count as critical elaboration?

Questions such as these were discussed until consensus was reached and then the coding protocols and definitions were refined to reflect this understanding.

When the codebook was used for the second set of pilot data, coders were in agreement slightly less than 50% of the time. This brought us to our next revision of the codebook where coders clarified the difference between feelings and thoughts and discussed the use of the data boxes. Infrequently, research participants ignored the boxes and wrote paragraphs that went on for several boxes. Coders determined that a paragraph would only be counted as one thought. The researcher and coders discussed changing the data collection protocols to include a projection of the data sheet so students could see an

example of listing one thought per box, even with multiple sentences. Coders also discussed the virtue of continuing to code by subcategory rather than just presence/absence of critical elaboration in order to be forced to identify why each thought was or was not an example of critical elaboration. Importantly, it was suggested by one of the coders that we ought to code one frame type in its entirety given that the different frames had different assumptions. This necessitated a hard look at all the frames as well as a discussion of different assumptions underlying each frame type. In looking at the frames themselves, the researcher noted that in two of the frames, many assumptions could be identified whereas in the other two frames, parallel ideas were not assumptions at all, but clearly stated. This necessitated a fine-tuning of the existing frames. As such, it was decided that the data collected to date should be pilot data and that new samples should be collected. After this revision, interrater reliability between the coders was calculated at 85.4% regarding the presence or absence of critical elaboration. Areas of remaining disagreement were then discussed until consensus was reached.

Research Design

In this 2 x 2, between groups, fully-crossed, factorial design (see Table 2), student participants were randomly assigned to read one of four different types of frames. Frame was operationalized in terms of voice and metaphor type.

Procedures

During a classroom meeting, four frames were systematically distributed to students. They were given 15 minutes to list their thoughts according to the thought-listing instructions (see Appendix C). These instructions were also projected on a screen

Table 2

Fully-crossed Factorial Research Design

Frames	Metaphor Type	
Voice	Humans apart from nature Active Voice (ANSF)	Humans a part of nature Active Voice (ASF)
	Humans apart from nature Passive Voice (PNSF)	Humans a part of nature Passive Voice (PSF)

in the front of the classroom. This procedure was piloted three times in order to ensure that directions were appropriate for this setting. Data were then collected.

Manipulation Check

At the bottom of the thought-listing form, participants were asked to respond to three prompts utilizing a 7-point semantic differential scale. The prompt root said "the text I just read portrayed humans as" followed by the anchor points: 1) impacting nature, not impacting nature, 2) connected to nature or disconnected from nature, and 3) a part of natural systems, apart from natural systems. The third item (a part of natural systems – apart from natural systems) was used as the manipulation check. It was hypothesized that mean scores would be lower for those who read the "humans as a part of nature" frame than those who read the "humans as apart from nature" frame. Lower mean scores would indicate that respondents were judging their frame as toward the "apart of nature" end of the semantic differential item. An independent samples *t*-test showed that those who read the "humans as a part of nature" frames had lower means scores than did those who read

the "humans as apart from nature" frame. This provided evidence that the frame manipulation was successful (see Table 3).

Hypothesis Testing

Data were cleaned and entered into SPSS. Data were screened for outliers and tests for normality and equality of variances were performed. The Kolmogorov-Smirnoff test for normality was significant (D (137) 0.157, p <. 001) indicating some departure from normality. However, analysis of Q-plots failed to show serious departures from normality. Data transformations were attempted and analysis of Q-plots suggested that such transformations failed to improve distributional shape. Thus, data analyses were performed on the raw scores. One case was eliminated as a univariate outlier as its z score was 3.1 standard deviations away from the mean. Levene's test for equality of error variances was not significant at the p<.05 level, F (133,3) = .921, p = .432. Hypotheses were tested using a two-factor analysis of variance.

Table 3

Manipulation Check

Metaphor Type	*n*	Mean	Standard Error
Systems	62	4.59	.25
Nonsystems	69	5.60	.24

t = -2.923, df = 129, p =.004

Potential Threats to Valid Inferences

Within any study there is a likelihood that the inferences drawn result from a cause or causes other than the variable or variables studied. The following tables (Tables 4-6) present the threats to making valid inferences, specifically by examining potential threats to internal validity, potential threats to external validity, and potential threats to statistical conclusions and providing information as to how these threats were controlled or avoided.

Table 4

Threats to Internal Validity

Threat	Controlled	Explanation
History	Yes	History was consistent across all groups.
Maturation	Yes	Due to the short duration of the experiment, maturation did not occur.
Testing	Yes	Each measurement tool was used only once.
Instrumentation	No	The measurement tool has been created for this study.
Statistical regression	Partially	Focus was on group differences (Frame Type). Also, there was no pretest and participants were randomly assigned to treatments.
Selection bias	Yes	Participants were randomly assigned to experimental groups.
Attrition	Yes	Due to the short duration of the experiment, there was no attrition.
Diffusion of treatment	Yes	Participants performed tasks independent of other participants.

Table 5

Threats to External Validity

Threat	Controlled	Explanation
Generality across subjects	Partially	Group differences were assessed.
Generality across settings	Yes	Settings were the same.
Generality across response	Unknown	Unknown
Generality across time	Yes	Participation in the study occurred just once.
Generality across behavior change agents	Yes	Same person did the interventions
Reactive experimental arrangements	Yes	Text use not uncommon.
Reactive assessment	Yes	No assessment /performance evaluation
Pretest sensitization	Yes	No pretest was administered.
Multiple-treatment interference	Yes	Participants were involved in just one experiment.

Table 6

Threats to Statistical Conclusions

Threat	Controlled	Explanation
Low statistical power	Yes	Large sample was available for pilot test.
Violation of assumptions	Yes	Statistical assumptions were assessed.
Unreliability of measures	Yes	Coders were trained and intercoder reliability was assessed.
Consistency of treatment implementation	Yes	Subjects were randomly assigned in each implementation and group differences were assessed.
Random irrelevancies in the experimental setting	Yes	Subjects were randomly assigned in each setting and group differences were assessed.
Random heterogeneity of subjects	Partially	Subjects were randomly assigned.

CHAPTER IV

RESULTS

The purpose of this study was to test the effects of two frame types on critical elaboration in the context of sustainability education. This chapter details the analysis course and reports results for data collected from participating college students in introductory level courses. Descriptive information about the participants and hypothesis tests are provided.

Sample Description

The study included 138 participants. Seventy of these participants were students enrolled in an introductory course in the Department of Parks, Recreation, and Tourism at the University of Utah. Sixty-eight of the participants were enrolled in an introductory course in the Department of Wildland Science at Utah State University. Each participant responded to three paragraphs of text (treatments) about the ecological concept of carrying capacity. The information in these paragraphs was a unique combination of metaphor type ('A Part of' or systems metaphor, and 'Apart From' or nonsystems metaphor) and voice ('Active' or 'Passive' language). Treatments were systematically assigned to students in each class, such that students responded either to an active systems frame, a passive systems frame, an active nonsystems frame, or a passive non-systems frame. Student responses were in the form of thought-listing and this technique

yielded 603 thoughts across all four frame types. Critical thinking did not vary by class (t = 1.42, p = .15)

Descriptive Statistics

The overall mean critical elaboration and descriptive statistics are shown in Table 7. Distribution was positively skewed and nonnormally distributed (see Figure 6).

Hypothesis Tests

In interpreting between subject effects, contrary to H_1, there was no significant interaction between voice and metaphor type (see Table 8). Comparison of main effect means, however, revealed significant differences between them at a $p <$. 05 (see Table 8), supporting H_2 and H_3. Critical elaboration scores were higher when systems metaphor frames were used than when nonsystems metaphor frames were used, and critical elaboration scores were also higher when active voice was used as compared to passive voice (see Table 9). Thus, the effects of framing and voice were independent and additive.

Table 7

Descriptive Statistics for Critical Elaboration Scores

n	Mean	Std. Dev	Skewness	Kurtosis
137	2.00	1.69	0.72	0.05

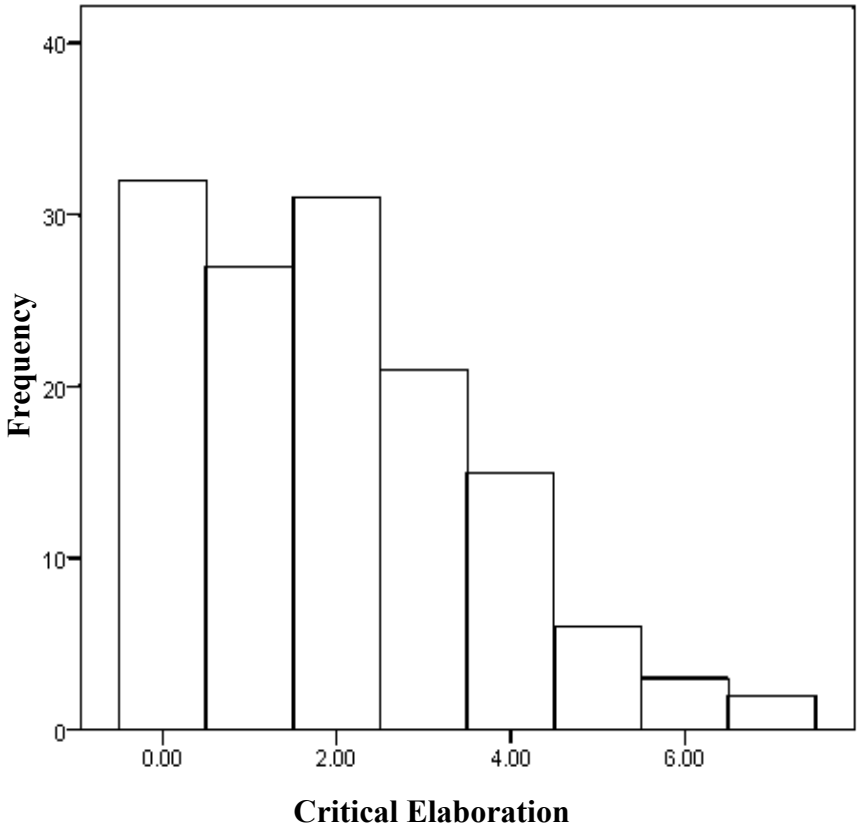

Figure 6. Distribution of Critical Elaboration

Table 8

Two-factor Analysis of Variance Results: Effects Of Two Language Frames Of Interest, Metaphor Type (2 Levels: 'A Part Of' And 'Apart From') and Voice (2 Levels: 'Active' Or 'Passive').

Frame	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Metaphor Type	15.322	1	15.322	5.723	.018	.041
Voice	14.004	1	14.004	5.231	.024	.038
MT * Voice	2.539	1	2.539	.948	.332	.007

Voice Eta^{2} = .036, Metaphor Type Eta_2 = .039

Table 9

Mean and Standard Error of Critical Elaboration Scores for Voice and Metaphor Type

Voice	Metaphor	Mean	Std. Error
Passive	Nonsystems	1.486	.277
	Systems	1.882	.281
Active	Nonsystems	1.853	.281
	Systems	2.794	.281

CHAPTER V

DISCUSSION

The purpose of this study was to test the impact of different frame types on critical elaboration. Critical elaboration was measured in a 2 x 2 factorial design using frames employing either active or passive voice and based in a metaphor that depicted humans as either a part of or apart from nature. Results support the hypotheses that active voice yields more critical elaboration than passive voice, as do frames that cast humans as a part of nature. This chapter includes an overview of the study, a summary of results, an integration of the results with previous research, study limitations, and implications for research and practice.

Study Overview

Many scholars believe language is not reflective of the world but rather that language defines and shapes it (Carroll, 1956; Lakoff & Johnson, 1980). Intentional language choices are essential in educational contexts because while language conveys surface meaning, it also broadcasts a deeper worldview. This "unspoken" element inherent in every communication is of fundamental interest to educators because of its inherent power. Students make sense of new information by fitting it in with what they already understand (Ausubel, 1968), and language activates underlying metaphors (Lakoff & Johnson, 1980) or schema (Anderson, Reynolds, Schallert, & Goetz, 1977;

Bransford, Brown, & Cocking, 1999) around which understandings and attitudes are based. Both framing and schema theory provided the foundation for this study, suggesting that language can be a powerful tool in creating a worldview that is based in sustainability.

Many models have been created that attempt to explain the path to sustainable or pro-environmental behaviors (Bamberg & Moser, 2007; Borden & Schettino, 1979; Hines et al., 1986; Kollmuss & Agyeman, 2002; Sia et al., 1986; Volk & McBeth, 1998). Common among them is both knowledge and attitude, yet these elements have not been assessed together in a common research framework. Thus, it became important to test both of these variables in a synthesizing context. Petty and Cacioppo (1986) assert that elaboration is the path to forming strong attitudes. Furthermore, critical thinking is recognized as an important step in understanding and evaluating information (Halpern, 1996). While elaboration and critical thinking are not the same thing, they have many similar attributes, making their synthesis valuable and logical in the context of sustainability education. Use of the thought-listing technique (Cacioppo, Von Hippel, & Ernst, 1997) allowed for open-ended and quantifiable measurement to assess the effects of different frames on these recognized antecedents of pro-environmental behavior.

Because common cultural metaphors are often antithetical to ecological reality and consequently pro-environmental behavior (Cachelin et al., 2010) it was necessary to challenge these metaphors when constructing frames. A review of introductory ecological textbooks provided insight into pervasiveness of language that resists the limited nature of matter, and in searching for an underlying metaphor or schema, it became clear that this language is rooted in the metaphorical concept that humans are

apart from natural systems rather than a part of them. Creating alternative frames required considering language that reinforces the "humans apart" metaphor and manipulating it. Words like "resources" and "habitat" connote difference where "food," "materials," and "home" connote sameness. The use of first person words, such as "I" and "we" evoke different meaning and feelings than third person words, such as "researchers" and "they." Finally, communicating ecological phenomena in an educational setting using examples that explicitly impact human populations rather than those that impact only nonhuman populations calls on readers to acknowledge that humans are a part of a larger system. Applying these subtle but fundamentally different frames to text was foundational to the design of this study.

Because passive voice has been recognized as problematic in the presentation of ecological information (Schellenberger & Nordhaus, 2005; Chehansa & Schleppegrell, 1998), frames were also designed to manipulate voice. Frames utilizing both metaphor types were created in active and passive voice. The following section discusses the results of this manipulation.

Summary of Results

The results of the study fully supported the hypotheses that frame type and voice can and do affect critical elaboration. The direction and significance of main effects were congruent with predictions. The systems metaphor frame (humans as "a part of" nature) elicited significantly more critical elaboration than the nonsystems metaphor, as hypothesized. Also as hypothesized, active voice elicited more critical elaboration than passive voice. There was no significant interaction effect between these two conditions.

Integration with Previous Research

This research supports the work of previous researchers in elaboration and critical thinking. Cognitive scientists Lakoff and Anderson (1980) and anthropologists Whorf and Sapir (see Carroll, 1956) discuss the idea that words matter, language patterns matter, and frames matter. They are proponents of the notion that language shapes rather than reflects reality, and while this research does not directly test that hypothesis, it allows us to see how thoughts change in response to different "languaging" of the same ideas.

Johnson and Eagly (1989) suggested that messages that are relevant and involving tend to foster elaboration. Both metaphor type and voice are manipulations of the involvement concept. Framing humans as a part of nature involves humans in a systems context such that nature is something in which all humans are involved. This may be one reason why that frame elicited more elaboration. Manipulation of voice from passive to active, and from "they" to "we" might also affect involvement. In light of the involvement research (Johnson & Eagly, 1989), it is particularly interesting to note that the effect size was larger for metaphor type than for voice. This is congruent with expectations given that manipulation of voice is a much more subtle change than manipulating a baseline metaphor and implying a different worldview.

Previous research about critical thinking is also germane to these results. It is often recognized as a combination of disposition and ability, rather than something that can be activated (Ennis, 1985; McCarthy, 1992). This study's data largely support those who consider critical thinking as episodic given that some conditions elicited more critical thinking than others. If critical thinking were a disposition, mean critical elaboration scores would not vary across frame type because systematic distribution

would attend to different dispositions. Yet, the positive skew of the distribution of critical elaboration scores overall may imply that some do not engage in critical thinking under any condition. In this sense, there is also support for the idea that critical thinking is dispositional in nature or that some just do not possess the ability or disposition to think critically. There is also the possibility that for some participants, the text itself was not compelling enough to activate critical thinking. This interpretation is in keeping with the literature that describes cognitive efficiency as mandating mental breaks, times when people do not engage in critical thinking and act as cognitive misers (Fiske & Taylor, 1984).

Critical thinking is also impacted by cognitive dissonance. Literature on dissonance suggests that there is an acceptable threshold (Festinger, 1957) beyond which critical thought will not occur. In looking at frames commonly used in ecology education, researchers (Cachelin et al., 2010; Chenhansa & Schleppegrell, 1998; Shellenberger & Nordhaus, 2005) noted more frequent use of passive voice and frames that cast humans as apart from nature. Manipulating these variables intentionally to create dissonance could conceivably have reduced critical elaboration, and muddied or even inverted the results. Perhaps because of the subtlety of the frame differences in this study, cognitive dissonance was not great enough to block critical elaboration.

In these ways, data are largely in keeping with existing research from both the persuasion and education literatures. Involvement and relevance of messaging may have played a significant role in elaboration; level of dissonance may have been subtle enough to work in favor of the hypotheses; and, while the functioning of critical thinking lacks

consensus in the literature, there are elements in this research to support its different interpretations.

Limitations

While this study provided interesting insights into framing and critical elaboration, there were several limitations. These include logistical issues such as sample size limits and limits to the sphere of inference due to the diversity of the participant pool and to the single-topic focus. Some of the elements the frames themselves may have also been a limitation. While every attempt was made to see that frames differed only by voice and metaphor type, the consequent word selections may have had more of an impact than was initially recognized.

The sample was largely one of convenience, comprised of 138 participants in two classes (a required ecology course for non-ecology majors at Utah State University, and a required Parks, Recreation and Tourism course at the University of Utah). Participants in introductory classes were selected intentionally because the most effective use of a thought-listing technique (Cacioppo et al., 1997) is with populations who are not steeped in knowledge regarding the concept being discussed. Depth of relevant knowledge increases the likelihood participants will respond to the message itself rather than their own background knowledge. While these criteria were met by using classes that were not for ecology majors, these classes may have been positively predisposed to nature such that the systems frames used may have avoided crossing the threshold into a condition so dissonant that critical thinking was blocked (Festinger, 1957). The results, while suggestive for this population, cannot be uncritically applied to all undergraduate populations.

The use of only one topic, in this case, carrying capacity, also limits the ability to infer that the same metaphor manipulations would be effective across all ecological topics. Creating frames that were equal in information given depth of treatment and number of assumptions was very challenging. Given this and the sample size, it made the most sense to create and test frames about only one topic, though the creation and testing of frames in other topics would expand the inferential sphere.

Because frames were constructed to manipulate the underlying metaphor of humans as a part of or apart from nature, the language differed. For example, the frame that depicted humans as apart from nature used the example of a botanist from the 11th century, whereas the frame that depicted humans as a part of nature used a more contemporary scientist, Thomas Malthus, whose work focused on human populations. While this selection was intentional, the time periods were so different that this may have been a source of variance. Additionally, examples of carrying capacity were very different. The frame that emphasized humans as apart from nature used Guam as an example of a diminished capacity for native plant species, while that frame that emphasized humans as a part of nature used Easter Island as an example of diminished capacity for humans. While these examples were intentional, it is possible that they introduced variance beyond the intended metaphorical manipulation. For example, the Easter Island example mentions cannibalism and many of the responses name that explicitly. Similarly, in the Guam example, snakes are mentioned and some participants expressed a visceral response. In manipulations of voice, differences existed. For example, the passive voice frame does not use the name Malthus, while the active voice

frame does. While none of the responses explicitly speak to Malthus, it is possible that this difference impacted responses.

Implications for Future Research

This study provides an interesting and important step towards understanding how framing can impact critical elaboration. Many valuable research questions follow from this work including the following: Is critical elaboration an important variable to measure the impact of environmental/sustainability education programs more broadly? Will manipulation of underlying metaphors elicit differences in critical elaboration when applied to different topics with a broader diversity of participants? Can alternative frames play a role in reducing misconceptions in ecology? Will a qualitative analysis of the thoughts listed show different response patterns between frame types and voice? All of these questions can serve to build on the current understanding of manipulating frames for increased understanding.

While the construct of critical elaboration was created for this study, it may play an important role in sustainability education programs evaluation more generally. A common critique of environmental education programs and their evaluation is the lack of information related to attitudes and to affective variables (Cachelin, Paisley, & Blanchard, 2009; Chawla, 2007). Critical elaboration as a more common program outcome and thought-listing as a more common measurement technique may attend to these issues. The thought-listing technique allows researchers to measure understanding through an examination of critical thinking attributes at the same time as they consider attitudes. Interpreting this same data through a qualitative lens may shed light on important and largely overlooked affective variables. The expanded use of both critical

elaboration and thought-listing may be very useful in programs that have pro-environmental behaviors as their goal.

In addition, there are several ways that the thought-listing technique might be used in sustainability education. For example, there are so many well-documented misconceptions in ecology, thoughts listed could be analyzed in terms of the presence or absence of misconceptions under each frame type. In addition, looking at the listed thoughts qualitatively may give insight into how framing impacts variables other than critical thinking. Many of these variables may be important antecedents of pro-environmental behavior.

To extend the generalizability of the study, future research might include working with a different and larger sample, for example, one that includes business majors, English majors, and engineering majors who are less likely to be positively predisposed to nature. Also, the practice of changing the underlying metaphor needs to be applied to other topics and issues in ecology. In this experiment, carrying capacity is discussed and while it may be inferred that this technique will have impact when applied to other topics, it would be valuable to see this technique applied to topics like climate chaos, biodiversity, energy flow, or matter cycling.

Finally, if results of this study hold across larger and different samples with different topics, it would be valuable to see if framing can impact other elements of the model proposed in the literature review. For example, does framing have the potential to impact norms or perceived behavioral control? While the results of this study and the literature support the idea of framing impacting critical elaboration in the context of pro-

environmental behavior models, studying what this variable contributes to individual model elements may be useful and important.

Implications for Practice

Currently, sustainability education is at best overlooking valuable tools and at worst undermining itself altogether. It is incumbent on sustainability educators to select frames intentionally, see that these frames are consistent with ecological realities, and acknowledge that there is no absolute neutrality in the presentation of information.

Wendell Berry notes if we are to rectify our relationships with each other and the environment, we must first rectify our language (Bowers, 2001). Appreciating the power of language and metaphor is key to achieving this goal. While this challenge seems straightforward, in practice, it is very difficult. Ultimately, this practice would ask educators to critically consider the metaphors tapped by common frames as well as voice. Ehrenfeld (2003) speaks to this idea:

> . . . learning, innovation, paradigm change, thinking out of the box, and so on, take place, first, by grabbing onto a metaphor that dissolves the problems that have stymied action. Then, if the actor is comfortable in the metaphor, she or he begins to look for rules that allow analysis, design, and practical action. (p. 2)

Beyond metaphor, alternative frames also call on educators to deeply consider what distinctions exist between education and advocacy.

By definition, environmental education is distinct from advocacy. An oft-quoted idea is that environmental education teaches you how to think not what to think. The North American Guidelines for Excellence in Environmental Education state:

> An educational curriculum must present different viewpoints, such as the pros and cons of forest fires. Different perspectives also need to be presented in a balanced way—one that does not bias the student toward any one perspective. (NAAEE, 2000, p. 5)

And while people often consider environmental education the province of K-12 educators, the sentiment is certainly relevant to higher education as well. Consider the following from Goodstein (2009) at Bard College, "Advocacy runs counter to education when understanding is sacrificed to political expediency. And yet, from fear of being falsely characterized as advocates, educators cannot now shy away from the implications of global warming science." These quotes make us aware of the difficulty educators face in navigating ecological issues, especially those that are social in origin. Data from this research speak directly to this issue in fundamental ways.

Because these data suggest that even a subtle shift in language yields different results, they support the idea that there is no neutrality in the presentation of information. Cultural moorings are revealed through frames. The idea that there is no neutrality is inherent in the design of the study itself. In a field tiptoeing around education vs. advocacy, a dependent variable with its foundation in the persuasion literature is certain to raise a red flag. Yet, how can sustainability educators avoid the persuasion literature when attitude is a factor in every sustainable behavior model? Perhaps the only way to do this is to disabuse ourselves of the notion that neutrality exists.

A more common approach to the tension between education and advocacy is to rely upon science, specifically reductionist empiricism. If students can see, touch, experience something, then it must be real and unbiased. If people can look closely at pieces then they can make inference to wholes. Science is celebrated for its objectivity and scientific writing traditionally demands excising all first person language, relying on passive voice, and removing researchers from their studies. Yet data from this study imply educators again consider the work of Knudtson and Suzuki (as cited in Bowers,

1999) or Sale who point out the value of subjective knowledge in terms of sustainability. Sale describes organic science as:

> a cumulative body of knowledge acquired over generations of direct experience and hypothesis testing within a bioregion—knowledge that often makes the difference between an adequate diet and starvation. Because of its intergenerational nature, organic science is interwoven with a cultural groups' understanding of interdependent relationships —which makes it part of the groups' moral code. (p. 42)

In contrast with organic science, empirical reductionist science secures its power and control over nature by claiming objectivity. In doing so it may replace culturally and geographically specific and relevant information with less useful information in the context of sustainability. According to Sale, this is no accident:

> Self-sufficiency, mutual aid, morality in the marketplace, stubborn tradition, regulation by custom, organic knowledge instead of mechanistic science—had to be steadily and systematically disrupted and displaced. All the practices that kept the individual from being a consumer had to be done away with so that the cogs and wheels of an unfettered machine called "the economy" could operate without interference. (p. 42)

Sale situates current thinking in the persuasive campaign of those who benefit from consumer culture. As science and technology are honored by society as the path to progress and an ethical world, it is also important to recognize the processes and products of science as threatening, and as a rationalization that maintains the status quo. Organic science reaches beyond more traditional science in that it bridges the gap between science and ethics and this approach to science may be a more honest science in the pursuit of sustainability.

While cultural narratives are based in a paradigm that suggests that earth equals resource, and that resources are unlimited, these data suggest that normalizing an alternative ecologically consistent articulation may have real value in education, particularly sustainability education. Lakoff (2006) suggests that this means "going on

the offense with your values and principles, repeating them over and over and over" (p. 31). Framing can be a powerful tool for sustainability and educators need to go on the offensive in terms of framing messages in keeping with a worldview that honors sustainability and in which citizens make choices to that end.

APPENDIX A

INSTRUCTIONS FOR THOUGHT-LISTING TECHNIQUE

I am about to distribute a sheet of paper that has three paragraphs of text on one side and a place for you to list your thoughts on the other. I would like you first to read the paragraphs on the front side of the paper; take your time and read them carefully. When you are finished reading, please turn your sheet over and list your thoughts, one per box, on the sheet. On the screen, you will see what the boxes look like and you will notice in my example that you may put more than one line in a box as long as it is just one thought. You will also notice that there are three questions at the bottom of the text; please respond to these after you list your thoughts. Does anyone have any questions? There is no need to put your name on these papers. This exercise is in no way related to your course grade (adapted from Petty & Cacioppo, 1986).

APPENDIX B

THOUGHT-LISTING FORM

Please record any thoughts you have regarding the passage you have just read. Please put *only* one thought in each box. You do not need to fill each box.

This is an example of listing one thought in each box, though this thought may take more than on line to express it can still fit in one box.

Please circle one:
This **text** I just read illustrates humans as:

Impacting nature 3 2 1 0 1 2 3 Not impacting nature

Connected to nature 3 2 1 0 1 2 3 Disconnected from nature

Apart from natural systems 3 2 1 0 1 2 3 Part of natural systems

APPENDIX C

CRITICAL EVALUATION CODEBOOK

The coding procedures and decision rules described in this manual are intended for the use of performing analysis of thoughts listed by students after exposure to intentionally framed ecology text for the purpose of understanding critical elaboration and its relation with associated variables. This analysis method retains some of the richness of student responses while allowing for quantification of variables. This method will allow for statistical analysis and hypothesis testing.

Data will be quantified through coding for the presence and absence of elements of critical elaboration. Critical elaboration, a construct developed from the concept of elaboration in the persuasion literature and critical thinking in the education literature, is defined as careful consideration of an issue characterized by thoughtful critique. Thinking skills utilized in critical elaboration include identifying and questioning unstated assumptions, suggesting alternatives, seeking clarification and/or challenge, and deriving an overall evaluation of, or attitude toward, the issue being presented.

Data coding for critical elaboration

Instructions:

You will be given a sheet of paper. On one side, you will have text that students were given to read. Familiarize yourself with this text. The other side has several boxes with student writing in them. There is one thought listed in each box. Code each thought separately as follows:

Code all the data for each frame separately. Carefully read each frame before you code for that frame and try to get the gestalt of the thought.

Decision-making protocols:

1. There must be one thought in the box. If the student has written a paragraph rather than listed thoughts, the maximum score the whole paragraph can receive is a 1.

2. Similarly some sentences express more than one thought; for example, "We should either use less or expect to die out." the maximum score this sentence can receive is a 1.

3. There must be an actual thought recorded – a one-word response, or a few words with no verb does not constitute a thought (unless it is the command form and the noun is implied). If there is no verb in any tense present, score the box as a 0 and move on to the next thought.

4. A thought is distinct from an emotion. Here we are only interested in thoughts. If the sentence or fragment expresses only an emotion, e.g., "it makes me feel sad," score the box as a 0 and move on to the next thought. Sometimes people precede thoughts with the word "feel"; for example: "I feel this is a big problem." Reading beyond the language to get at the gestalt is a critical part of coding. To determine whether something is actually an emotion, try replacing the word "understand" or "believe" - e.g., "I believe this is a big problem" – as opposed to "I believe sad." The second sentence doesn't work because it really is an emotion rather than a belief.

5. Decide whether the thought that has been listed is related to the topic of the text – i.e., carrying capacity. (Sometimes thoughts are about the manner of presentation rather than the topic itself.) If the thought is topic-relevant, then continue. If it is not, score the box as a 0 and move on to the next thought.

6. Decide if the comment is summative in nature, or if it is more than that. If the comment is merely a summation, with no overall position taken or evaluation given, score the box as a 0 and move on to the next thought. If it is not, continue.

Critical elaboration subcategories and coding criteria:

Determine if each thought (individually) meets any of the criteria below. Note that each thought can be given only one point, so as soon as you have identified it as an example of one of the subheadings below, score it as a 1 and begin the process again with the next thought. There is no need to track which of the following subcategories of critical elaboration each thought falls under.

Identifying / Questioning Unstated Assumptions
Any text includes assumptions. An assumption is an unstated premise, or something that is being taken for granted. In the text that research participants read, for example, there are assumptions about the relationship between humans and nature, i.e., their role as managers vs. members, and probably many others. If participants describe or question assumptions, score the thought as a 1; if not, continue.

Looking for Alternatives / Suggesting an Action
Participants may suggest alternatives to some scenarios mentioned in the text, perhaps other management techniques or behaviors that would help avoid the problem described altogether, for example, "What about species reintroduction." If participants describe alternatives or the importance of alternative behaviors that are not stated in the text, score the thought as a 2; if not, continue.

Seeking Clarification And/Or Challenge
Participants may ask questions about the topic described. If these questions are about the information in the passage itself or about themselves in the context of the information, score it as 1. If it is speculation about the future of a specific species or general outcome with no extension of the concept itself, score the thought as a 3 and continue. For example, "what will happen to the snakes" is speculation whereas "Have people always exceeded carrying capacity of their region" is seeking clarification.

Deriving An Overall Evaluation Of, Or Attitude Toward, The Issue Being Presented
Deriving an overall opinion or attitude is based on a judgment of some sort. Participants may show their overall opinion by stating agreement or disagreement with the information in the passage, or may describe more specific attitudes toward specific elements of the passage.

An attitude is a pro or con statement about something as opposed to a general feeling. For example, “We are a huge part of this problem” shows that a judgment has been made, as opposed to a expressing a feeling. If this is the case, score the thought as a 4. If not, and if it has not met any of the criteria described above, score the thought as a 0 and move on to the next thought.

APPENDIX D

ACTIVE SYSTEMS FRAME (PART OF NATURE)

Picture a 5-gallon water-cooler bottle. When you tip it over, the water glugs slowly out of the narrow neck of the bottle. The size of the neck limits how quickly water pours out. Thomas Malthus, a political economist, observed that human population growth works similarly. A population grows exponentially when unchecked, but the things needed by a population (e.g., food, water) do not, creating a "bottleneck" on population growth. This population has then reached its carrying capacity.

Carrying capacity is the maximum number of a species (e.g., humans, earthworms, sagebrush) which can be supported without permanently damaging their homes. To find balance, we must consider the needs of our fellow species and future generations.

For example, Easter Islanders enjoyed a well-developed society in a remote location. As their population grew, they harvested certain tree species to extinction and could no longer build the wooden boats they used to fish. Without access to their major food source, Islanders resorted to eating land birds. Given this combination of diet and deforestation, they effectively condemned all land birds to extinction. In just a few centuries, the people of Easter Island wiped out their forest, drove their plants and animals to extinction, and saw their complex society spiral into chaos, cannibalism, and, eventually, their own extinction.

The collapse of this island system gives us insight into the repercussions of exceeding carrying capacity. This same principle applies even when we can not immediately see the consequences in the complexity of our globalized system. We can use the principle of carrying capacity to inform our choices and to recognize the bottlenecks that apply to us all.

APPENDIX E

ACTIVE NONSYSTEMS FRAME (APART FROM NATURE)

Picture an old-fashioned water barrel. This water-barrel has sides made of wooden staves, each one a different length. The shortest stave limits the amount of water the barrel holds. A German botanist named Liebig observed that plant growth works similarly. Each barrel stave represents a resource, whether it be light, nutrients, or water. Whatever resource runs out first is the limit to growth. We call this idea carrying capacity when applied to populations. Ecologists recognized the breadth of this concept and have applied Liebig's idea to populations of all species, not just plants.

Carrying capacity is defined as the maximum population of a given species (e.g., earthworms, sagebrush, elk) that can be supported without permanently impairing the productivity of a habitat. Managers try to balance the resources needed by current populations with those needed by future populations, as well as with the resources needed by other species.

For example, Guam is an isolated tropical Pacific island with a high percentage of endemic species, including over 600 species of native plants. Cargo ships inadvertently brought brown tree snakes to the island, and without any natural predators, their population exploded. Snakes hunted 9 of the 11 native bird species and 2 of the 3 native bat species to extinction. With so many birds and bats gone, many of them important pollinators, researchers now predict the local extinction of many native plants as well. Without suppressing snake populations, managers predict populations of many species will eventually be driven to extinction.

We can see how resources limit populations in this island system. Resource managers can balance current and future resource needs as well as the resource needs of one population with another by understanding carrying capacity. Managers across the

globe use the principle of carrying capacity to manipulate resources, like shortening and lengthening Liebig's barrel staves.

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APPENDIX F

PASSIVE SYSTEMS FRAMES (PART OF)

Picture a 5-gallon water cooler bottle. When tipped over, water glugs slowly out the narrow neck of the bottle. How quickly water can be poured out is limited by the size of the neck. It has been observed by political economists that human population growth operates similarly. A "bottleneck" limit on population growth is created when the things needed by a population (e.g., food, water) do not grow exponentially as the population does. Carrying capacity has then been reached by the population.

The maximum number of a species (e.g., humans, earthworms, sagebrush) which can be supported without permanently damaging their homes is termed carrying capacity. To find balance, the needs of our fellow species and future generations must be considered.

On a remote island, a well-developed society was enjoyed by Easter Islanders. As their population grew, certain tree species were harvested to extinction and the wooden boats used for fishing could no longer be built. Without access to a major food source, eating land birds was their last resort. Given this combination of diet and deforestation, all land birds were effectively condemned to extinction. In just a few centuries, forests were wiped out, plants and animals were driven to extinction, and a complex society spiraled into chaos, cannibalism, and eventually its own extinction.

Insight into the cascading repercussions of exceeding carrying capacity can be seen through the collapse of this island system. This same principle is applied even when simple feedback loops are obscured in the complexity of a globalized system. The principle of carrying capacity can be used to inform choices and the recognition that the bottlenecks apply to us all.

APPENDIX G

PASSIVE NONSYSTEMS FRAME (APART FROM)

Picture an old-fashioned water barrel. This water-barrel has sides made of wooden staves, each a different length. The amount of water the barrel holds is limited by the shortest stave. It was observed by a German botanist that plant growth works similarly. A resource is represented by each barrel stave, whether it be light, nutrients, or water. The limit to growth is whatever resource runs out first. Applied to populations, this is called carrying capacity. The breadth of this concept was recognized by ecologists and this idea has been applied to populations of all species, not just plants.

The maximum population of a given species (e.g., earthworms, sagebrush, elk) that can be supported without permanently impairing the productivity of a habitat is defined as carrying capacity. Balancing the resources needed now with those needed by future populations, and balancing the needs of one population with another is the goal of resource managers.

For example, Guam is an isolated tropical Pacific island with a high percentage of endemic species, including more than 600 native plants. Brown tree snakes were inadvertently brought to the island, and without any natural predators, their population exploded. Nine of the 11 native bird species as well as 2 of the 3 bat species were hunted to extinction by the snakes. With so many birds and bats gone, many of them important pollinators, the local extinction of several native plants is predicted. Without suppressing snake populations it is believed that many species will eventually be driven to extinction.

In this island system, the ways that populations are limited by resources can be seen. Understanding carrying capacity, the current and future resource needs of a population can be balanced as can the resource needs of one population relative to

another. The principle of carrying capacity of manipulation of resources is used by managers across the globe, like shortening and lengthening Liebig's barrel staves.

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